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PHYSICS ABSTRACTS

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SECTION A OF SCIENCE ABSTRACTS

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The monthly Author Index, List of Journals, Errata and Notes follow immediately after the last page of abstracts.

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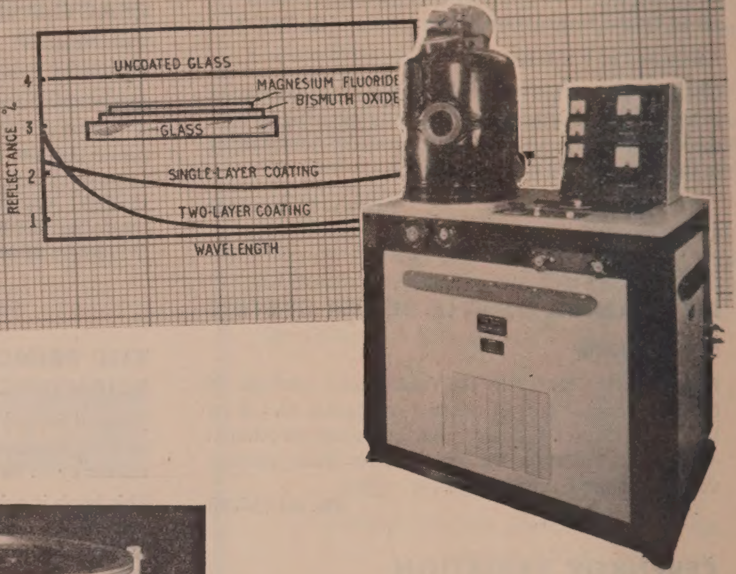

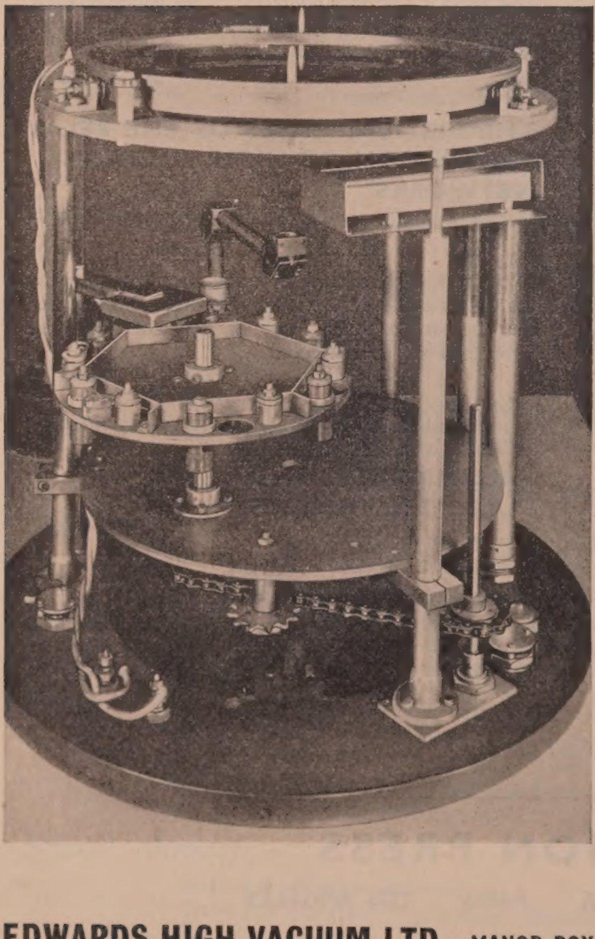

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PHYSICS ABSTRACTS

Volume 62 AUGUST 1959 Number 740

MATHEMATICS

512.9 : 530.145

717. NUMBER OF INDEPENDENT SCALARS DETERMINED BY ENSOR QUANTITIES. P.Leruste.

.R. Acad. Sci. (Paris), Vol. 248, No. 8, 1121-3 (Feb. 23, 1959).
n French.

The number, I, of independent scalars which can be formed by ontracted multiplication from N tensor quantities $T^{(i)}$ (i = 1,2,....N) s shown to be given by:

$$I = (\sum_i n_i p_i) - k,$$

here n_i is the number of independent components of $T^{(i)}$, $p_i = 1$ or 2 ccording to whether the coordinates of $T^{(i)}$ are real or complex and is determined by the number of covariant directions which the $T^{(i)}$ dmit. This result may be used to enumerate all the possible coupngs between different fields or in the Lagrangian theory of nonnear fields. T.R.Carson

513.3

718. A METHOD OF CALCULATING THE SOLID ANGLE UBTENDED BY A CIRCULAR APERTURE. M.Naitō.

. Phys. Soc. Japan, Vol. 12, No. 10, 1122-9 (Oct., 1957).

Practical formulae in terms of elliptic integrals are derived hich are useful for calculating the solid angle subtended by a cirular aperture at a point which is not on the axis of the aperture. ike the familiar formulae in terms of zonal harmonics, these formlae can be used not only to calculate the solid angle with an accurcy of 4 significant figures, but are also applicable to cases in which e former formulae cannot be employed owing to their slow rate of onvergence. The results of some preliminary calculations are bulated.

513.342

719. SOLID ANGLE CALCULATION FOR A CIRCULAR DISK. .Paxton.

ev. sci. Instrum., Vol. 30, No. 4, 254-8 (April, 1959).

A general expression for the solid angle subtended by a circular sk is derived in terms of complete elliptic integrals of the first d third kind. The elliptic integral of the third kind is reduced in rms of Heuman's lambda function, which has been tabulated. By ansformation of the double integral $\Omega = \iint \sin\theta d\theta d\beta$ into a single e integral, the solid angle can be conveniently determined. Since e solution involves only tabulated functions, it is well suited for sk calculation.

513.83

720. TOPOLOGICAL METHODS OF LOCATING CRITICAL OINTS. J.C.Phillips and H.B.Rosenstock.

Phys. Chem. Solids, Vol. 5, No. 4, 288-92 (1958).

Relations between the critical points of a function on and terior to a closed surface are presented. The derivation uses e rigorous formalism developed by Morse (1925), and extends sults previously presented [J. Phys. Chem. Solids, Vol. 2, 44 957)]. A discussion of the limitations of the previous treatment is ven. The previous treatment is then refined and the results comred with those of the Morse theory.

517.56 : 538.3

21. ON TOROIDAL FUNCTIONS. S.C.Loh.

nad. J. Phys., Vol. 37, No. 5, 619-35 (May, 1959).

The general solutions of Laplace's equation in toroidal coordines have been derived, both for the three-dimensional and the ial symmetrical cases. Also, the general theory and properties toroidal functions have been briefly outlined. The numerical tables r the zonal and the tesseral toroidal functions were calculated by e I.B.M. 650 computer at the University of Toronto, and are cluded.

518.2 : 512.52

7722. MATHEMATICAL TABLES. VOLUME 2. TABLES OF EVERETT INTERPOLATION COEFFICIENTS. L.Fox.

London: Department of Scientific and Industrial Research (National Physical Laboratory) (1958) 61 pp.

These tables give values of the second order $[E_2(p), F_2(p)]$ and modified fourth order $[P_4(p), Q_4(p)]$ coefficients in Everett's central difference interpolation formula

$$f_p = (1 - p)f_0 + pf_1 + E_2(p)\delta_m^2 f_0 + F_2(p)\delta_m^2 f_1 + P_4(p)\beta^4 f_0 + Q_4(p)\beta^4 f_1 + \cdots\cdots\cdots$$

where δ_m^2 denotes modified second central difference and β^4 denotes $\frac{1}{100} \times$ (modified fourth central difference). Coefficients $E_2(p)$, $F_2(p)$ can be used with ordinary second central differences to give results correct to third differences, the full formula requires differences modified by the "throw-back" device. E_2 and F_2 are given to nine places of decimals, P_4 and Q_4 to five places of decimals, $p = 0 - (0.0001) - 1$. These tables may be compared with those contained in Tracts for Computers No. 5 which give E_2, F_2, E_4, F_4, E_6, F_6, E_8, F_8 to ten places of decimals for $p = 0 - (0.001) - 1$, with some auxiliary tables, at wider intervals of the argument p, givine exact values, and differences of these functions, together with some values of E_{10}, F_{10}, E_{12} and F_{12}. The main advantages of the present tables are the finer interval for p, and the adjustment of the coefficients of the fourth central differences. These tables would usually be employed with printed tables givine modified central differences. There is also a short table to facilitate computation of differential coefficients. N.L.Johnson

518.5

7723. THE MATHEMATICAL CHARACTERISTICS OF THE FINAL VERSION OF THE C.S.C.E. PISA COMPUTER. A.Caracciolo and L.Guerri.

Nuovo Cimento, Vol. 12, No. 2, 111-15 (April 16, 1959). In Italian.

A description is given of the computer being built at the C.S.C.E. with particular reference to the solution adopted for the modification of the instructions by means of "parametric cells".

518.5

7724. MEMORIES AND INPUT—OUTPUT OF THE FINAL VERSION OF THE C.S.C.E. COMPUTER.

A.Caracciolo, G.Cecchini, G.B.Gerace, M.Falleni and A.Sabbadini.
Nuovo Cimento, Vol. 12, No. 2, 116-22 (April 16, 1959). In Italian.

A description is given of the connections between memories, input—output units and the central part of the computer under construction at Pisa. The logical design takes into account the possibility of future enlargement of the external units and auxiliary memories of the computer.

518.5

7725. ELECTRONIC CRITERIA IN THE DESIGN OF THE C.S.C.E. COMPUTER. I. G.Cecchini, G.B.Gerace and S.Sibani.

Nuovo Cimento, Vol. 12, No. 2, 123-5 (April 16, 1959). In Italian.

The criteria adopted in planning the smaller machine at present working at the "Centro Studi Calcolatrici Elettroniche" of Pisa University are discussed.

518.5

7726. ELECTRONIC CRITERIA IN THE DESIGN OF THE C.S.C.E. COMPUTER. II. G.Cecchini and G.B.Gerace.

Nuovo Cimento, Vol. 12, No. 2, 126-9 (April 16, 1959). In Italian.

Experience acquired from the smaller machine is described together with some new criteria adopted in planning the final machine, which is being built at the "Centro Studi Calcolatrici Elettroniche" of Pisa University.

518.5

7727. USE OF THE C.S.C.E. PISA SMALLER COMPUTER IN THE SOLUTION OF SOME PROBLEMS. E.Fabri and L.Guerri.
Nuovo Cimento, Vol. 12, No. 2, 138-43 (April 16, 1959). In Italian.

A report is given on problems solved or being solved on the smaller machine and on some experiments with modern computing techniques.

518.5 : 681.142 : 621.317.79

7728. SOLUTION OF POLYNOMIALS BY USE OF AN ELECTROMECHANICAL SYNTHESIZER. H.D.Schwetman and C.Burmeister.
Rev. sci. Instrum., Vol. 30, No. 2, 94-7 (Feb., 1959).

The roots of polynomials of high degree are obtained with a stated accuracy in a time of 10-30 min by use of an electromechanical harmonic synthesizer. The machine consists of sine-cosine potentiometers which are driven by meshed gears to produce sinusoidal potentials of frequency f, 2f, 3f, · · · . The algebraic polynomial is transformed into a trigonometric polynomial in which the terms are expressed in multiple angle form and applied to the machine. As the fundamental gear is rotated through 180°, the potentials are summed in a recording high impedance voltmeter in such a manner that when the curve $f(\theta) = 0$ passes through zero values, the angles are read from a large dial and the roots $x = r \cos\theta$ are obtained. Examples of the solutions are given, and the results of some twenty-five solutions reported to show an average accuracy of 1.19% and an average time of solution of 16 min. For higher accuracy a time of about 7 min is required for each additional substitution, until an accuracy of 0.30% may be obtained. Multiple or repeated roots are obtained by use of the factor theorem and repeated differentation.

519.21 : 534.

CORRELATION OF A FINITE DISTANCE POINT SOURCE.
See Abstr. 6668

ASTROPHYSICS

522.6 : 535.345.6

7729. ON SOME NEW BIREFRINGENT FILTERS FOR SOLAR RESEARCH. Y.Öhman.
Ark. Astron., Vol. 2, Paper 15, 165-9 (1958).

Physical principles involved in the design of a new filter for H_α light are outlined, and the practical application of the filter to solar research is illustrated by photographs of the intense flare of 3 July 1957. See also Abstr. 3031 (1959). D.R.Barber

522.6 : 535.317

APPROXIMATE CORRECTION TO THE LOBE EFFECT IN RADIOASTRONOMY. See Abstr. 6683

523.164

7730. A 16 ELEMENT INTERFEROMETER OPERATING AT 9300 Mc/s. M.Pick-Gutmann and J.L.Steinberg.
C.R.Acad. Sci. (Paris), Vol. 248, No. 17, 2452-4 (April 27, 1959). In French.

A short note giving a description of the interferometer which is 23 m long and consists of 16 parabolic mirrors each 1.1 m in diameter. The resultant fringes are separated by 1 degree and have a width between points of half intensity of 4 min of arc. Some observations of the sun made with a reduced version of the interferometer consisting of 8 mirrors are also reported. C.Hazard

523.164.32

7731. A RADIO IMAGE OF THE SUN WITH 3.2 CM WAVES. V.V.Vitkevich, A.D.Kuz'min, A.E.Salomonovich and V.A.Udal'tsov.
Dokl. Akad. Nauk SSSR, Vol. 118, No. 6, 1091-3 (Feb. 21, 1958). In Russian.
English translation in: Soviet Physics — "Doklady" (New York), Vol. 3, No. 1, 12-14 (Jan.-Feb., 1958).

A 31 m diameter paraboloid reflector has been fashioned in the ground and is used at wavelengths of 3.2 and 10 cm. The instrument can be made to scan the solar disk and some preliminary radio brightness contours are presented. H.J.A.Chivers

523.164.42

7732. AN ACCOUNT OF THE DISCOVERY OF JUPITER AS A RADIO SOURCE. K.L.Franklin.
Astron. J., Vol. 64, No. 2, 37-9 (March, 1959).

The author describes the events which led to his joint discovery in 1955 with Burke of the radio emissions from the planet Jupiter. These intermittent emissions observed on the 22 Mc/s Mills Cross were found to move slowly in right ascension thus ruling out a terrestrial or galactic origin. R.D.Davies

523.164.42

7733. RADIO FREQUENCY EMISSION FROM THE PLANET JUPITER. T.D.Carr.
Astron. J., Vol. 64, No. 2, 39-41 (March, 1959).

A review of present knowledge of the characteristics of radio emission from Jupiter — the rotation period of the source, the polarization, the frequency spectrum and the noise-like character of the emission. R.D.Davies

523.164.4

7734. NON-THERMAL SOLAR SYSTEM SOURCES OTHER THA JUPITER. H.J.Smith.
Astron. J., Vol. 64, No. 2, 41-3 (March, 1959).

A review of low frequency observations of radio emission fro the planetary system. Mars, Neptune and Uranus have flux densiti less than 10^{-21} Wm^{-2} $(\mathrm{c/s})^{-1}$. Comets, Venus and Saturn do not sh convincing evidence of being non-thermal radio sources. Jupiter i a non-thermal source. R.D.Davi

523.164.

7735. PLANETARY RADIATION AT CENTIMETER WAVE LENGTHS. C.H.Mayer.
Astron. J., Vol. 64, No. 2, 43-5 (March, 1959).

The results of short wavelength observations of thermal radia tion from the planets are summarized. Venus has an apparent bla body temperature of about 550°K in the 3 to 10 cm range, falling t near the infrared radiometric value at 0.86 cm. Jupiter has a tem perature of 150°K at 3 cm rising probably to 600°K at 10 cm. Ma and Saturn have also been detected. R.D.Davi

523.

7736. ORIGIN OF THE LUNAR CRATERS AND MARIA. W.G.van Dorn; Z.Kopal.
Nature (London), Vol. 183, 737, 737-8 (March 14, 1959).

Kopal's emphasis on the damage arising from seismic waves the meteor impact theory of crater formation, and his comet impa theory of the maria, are criticized on the basis of data derived fr terrestrial nuclear explosions. Kopal replies that such considera are not of direct relevance to lunar conditions, and reiterates the importance of the cumulative effect of seismic disturbances. R.A.New

52

7737. OBSERVATIONS OF JUPITER, SATURN, AND VENUS, I 1958. A.P.Lenham.
J. Brit. Astron. Soc., Vol. 69, No. 4, 163-7 (May, 1959).

A brief summary is given of observations made primarily w the 40 in. refractor (power 550) at the Yerkes Observatory. For Jupiter, only a few interesting changes are reported. Observatio were distributed as follows: Jupiter, Dec. 12 to Aug. 3 (47 nights Saturn, Apr. 15 to Oct. 6 (20 nights); Venus, Aug. 9 (1 observatio Where observations were made with other than the 40 in. refrac tor, a note is included to this effect.

523

7738. COSMIC DUST IN THE ATMOSPHERE. D.W.Parkin and W.Hunter.
Nature (London), Vol. 183, 732-4 (March 14, 1959).

The following were examined: melt-water from the wall of West Greenland crevasse; filtered water exposed on Bardsey Isl (North Wales) lighthouse, and on St. Agnes, Isles of Scilly (Cornwall); and gelatine-coated Perspex slides exposed from high-fly aircraft over S.England. All contained samples of undoubtedly meteoritic dust in the form of black, or silvery magnetic spheru ranging in size from 5 to 35μ diameter (median, 20μ). In additio

etallic flakes of fine-grained polycrystalline Fe, up to 240μ long,
id 100μ wide, of probably extra-terrestrial origin were
esent. Confirmation of cosmic origin was given by the presence
Ni at a concentration of $> 5\%$ (Isles of Scilly samples).

D.R.Barber

523.745 : 537.591.15

SOLAR ACTIVITY AND COSMIC-RAY BURSTS.
e Abstr. 7133

523.75

'39. STUDY OF SOLAR TURBULENCE BASED ON PROFILES F WEAK FRAUNHOFER LINES. J.H.Waddell, III.

strophys. J., Vol. 127, No. 2, 284-301 (March, 1958).

Photoelectric observations of the profiles of eleven weak
raunhofer lines were made through the 50 ft vacuum spectrograph
the McMath-Hulbert Observatory. These profiles were obtained
six positions on the solar disk. Corrections for scattered light
d instrumental profile applied to the observed profiles were small.
ne mean probable error for any point on a profile ranged from 0.1
0.3 per cent according to the position of the profile on the solar
sk. Pecker's method of weighting functions was used in the analy-
s of the line profiles. The profiles of both high- and low-excita-
on lines are well represented by a broadening due to non-iso
opic turbulence. The centre-to-limb variation of the central in-
nsity of the observed lines could be predicted within 1.0 per cent
d within 0.5 per cent for many of the lines. Similar agreement
as obtained for the predicted and observed half-widths. All pre-
cted values were obtained from the computations, in which the
dial random turbulent velocity was set equal to 1.8 km/sec, and
e tangential random turbulent velocity was set equal to 3.0 km/sec.

523.75

'40. AN INVESTIGATION OF BRIGHT AND DARK SURGES BSERVED ON THE SUN. K.Lodén.

rk. Astron., Vol. 2, Paper 14, 153-63 (1958).

Results obtained from a continuous solar patrol at Anacapri,
ly, during 1955-1956, using a Lyot—Öhman polarizing monochrom-
or with H_α filter (bandwidth, 1 A). Among the more important
pects of the investigation discussed are: (1) flare and surge
tivity; (2) correspondence between flares and dark surges;
heliographic latitude variation for flares; (4) lengths, duration,
rection and velocities of dark surges; (5) association of surge
tivity and solar radio-emission.

D.R.Barber

523.77

41. Hα PROFILES IN THE CHROMOSPHERE. E.v.P.Smith.

trophys. J., Vol. 126, No. 3, 529-36 (Nov., 1957).

Profiles of Hα in the chromosphere were obtained from spectra
en with the 16 in. coronagraph and 13 m spectrograph of the
ramento Peak Observatory. The spectra refer to eight different
ghts in the chromosphere, covering a range of approximately
1000 km. At lower heights the profiles are strongly reversed, even
er complete correction for the seeing excursions of the limb.
h increasing height, they become flat-topped and slightly narrower,
ally approaching a Gaussian form.

523.77

2. THE PROFILE OF Hα DURING THE LIMB FLARE OF BRUARY 10, 1956.

oldberg, O.C.Mohler and E.A.Müller.

rophys. J., Vol. 127, No. 2, 302-7 (March, 1958).

Profiles of the Hα line in a very bright loop prominence associ-
d with the great limb flare of February 10, 1956, show pro-
nced violet asymmetries. Despite the fact that the centres of
erent profiles made at several points in the line on two different
osures, exhibit relative Doppler displacements as high as 0.8 A,
shapes of all the profiles can be accounted for by the super-
ition on the main Hα profile of an additional component centred
veen 1.5 and 2.0 A to the violet. The possibility is discussed
the asymmetry may have been caused by the presence of abnor-
amounts of deuterium, presumably generated by nuclear re-
ons during the flare event. It is concluded that, although the evi-
e for deuterium is not conclusive, it would be extremely import-
to observe other similar flare-associated prominences in the
re, with modern high-dispersion spectrographs. Observations
ld also be made simultaneously on at least one additional line of
lement other than hydrogen, in order to eliminate velocity effects.

523.77

7743. ON THE INTERPRETATION OF PROMINENCE SPECTRA. I. BALMER SERIES LINE WIDTHS. J.T.Jefferies and F.Q.Orrall.

Astrophys. J., Vol. 127, No. 3, 714-25 (May, 1958).

Line widths, derived from a set of high-dispersion spectra in the Balmer series Hα—Hϵ have been used to show that the assumption of a constant-source function for Hα in prominences is not, in general, correct. It is pointed out that, with the present ignorance of prominence conditions, very little information can be obtained from the Hα line alone but that, when coupled with spectra in other Balmer lines, the Hα line may possibly provide a basis for inferring the run of physical conditions with depth. It is suggested that the common procedure of determining a kinetic temperature and turbulence from hydrogen and helium may also be erroneous.

523.77

7744. INTENSITY OF SOLAR LYMAN-ALPHA AND ADJACENT ULTRAVIOLET EMISSION LINES.

E.T.Byram, T.A.Chubb, H.Friedman, J.E.Kupperian, Jr and R.W.Kreplin.

Astrophys. J., Vol. 128, No. 3, 738-40 (Nov., 1958).

Lists new measurements taken during the I.G.Y. period together with data obtained on the adjacent ultraviolet range from 1225 to 1350 A.

523.77

7745. ANALYSIS OF EMISSION CORONA 1942-1955 FROM CLIMAX SPECTROGRAMS. M.C.Bretz and D.E.Billings.

Astrophys. J., Vol. 129, No. 1, 134-45 (Jan., 1959).

Climax measurements of coronal emission-line (λ 5303 and λ 6374) intensities for the years 1942-1955 were converted to an absolute scale, averaged over each solar rotation at each 5° position angle, then summed over the active zone on the limb. Curves showing the variation of the emission with time are presented. The total emission in both coronal lines follows the sunspot cycle closely. For λ 6374, however, the maximum at sunspot maximum is highly irregular and much less pronounced than for λ 5303. The strong peak in the λ 6374 emission during 1943, reported by Arosa, is not confirmed. A study of the distribution of emission with latitude, at different parts of the sunspot cycle, is also presented. It is concluded that, although both electron density and electron temperature appear to be higher at sunspot maximum than at sunspot minimum, the intensity of emission in both λ 5303 and λ 6374 is determined primarily by electron density. It is concluded also that for several months after the beginning of a new sunspot cycle an aggregate of cooler coronal gas from the preceding cycle remains near the solar equator.

523.77

7746. THE CONTINUOUS SPECTRUM OF THE LOW CHROMOSPHERE. R.G.Athay; G.I.Thompson.

Observatory, Vol. 79, 12-14, 14-15 (Feb., 1959).

Thompson's conclusion (1958) that Rayleigh scattering by neutral H atoms is the main contribution to the formation of the chromospheric continuum at low levels is shown to be invalid. It is demonstrated that good agreement exists between observed values of the intensity ratio,

$$\Delta \log I^* = [(I_{ch}/I_{co})_\lambda/(I_{ch}/I_{co})_{4700}]$$

(where ch = chromosphere and co = corona) if the alternative mechanism of electron scattering plus H^- radiation is envisaged. In reply, Thompson defends his original conclusion with some reservations.

D.R.Barber

523.852.22

7747. MAGNETIC DIPOLE FIELDS IN PLANETARY NEBULAE.

G.A.Gurzadyan.

Dokl. Akad. Nauk SSSR, Vol. 120, No. 4, 734-8 (June 1, 1958). In Russian. English translation in : Soviet Physics - "Doklady" (New York), Vol. 3, No. 3, 488-91 (May-June, 1958).

The observed variety of shape and structure may be explained by supposing that planetary nebulae are distorted by "non-point" dipole fields, the length L of the dipole being comparable with the linear dimension R of the nebula. It is reported that calculated isophots for various field strengths and values of L/R reproduce almost all known shapes, and provide good agreement with the observed structure of various nebulae. Non-uniform expansion is accounted for in a brief discussion of expanding nebulae subject to magnetic drag.

R.A.Newing

523.873 : 535.332

COLLISION BROADENING AND SHIFT IN THE RESONANCE LINE OF CALCIUM. See Abstr. 6706

523.877

7748. CONTRIBUTION OF BALMER LINES TO THE U MAGNITUDE ON THE PHOTOELECTRIC 3-COLOUR (U,B,V) ULTRAVIOLET, BLUE, AND YELLOW SYSTEM.
A.M.Rozis-Saulgeot.
C.R.Acad. Sci. (Paris), Vol. 248, No. 17, 2455-7 (April 27, 1959).
In French.

The modification of the ultraviolet magnitude by the presence of the Balmer line spectrum is defined by the magnitude difference, ΔU, between the magnitude computed on the assumption of a stellar continuum only, and that calculated after taking account of the Balmer absorption lines in the u.v. region. For the A-stars, ΔV varies from $0^{m}.21$ (A7) to $0^{m}.25$ (A0) as compared with ΔB (blue) values of $0^{m}.085$ and $0^{m}.082$ respectively. D.R.Barber

525.3

7749. PLANETARY ORBIT CHART. F.P.Callahan, Jr.
J. appl. Phys., Vol. 30, No. 3, 444-5 (March, 1959).

The twofold infinity of possible planetary orbits is reduced to a single infinity by normalizing the units and is represented on a chart, by the aid of which a complete orbit together with the velocity at each point can be obtained from given initial data. A computational procedure is also outlined. G.A.Chisnall

525.3 : 530.12

VERIFICATION OF GENERAL RELATIVITY BY MEANS OF ARTIFICIAL PLANETS. See Abstr. 6493

525.3 : 551.510.535

EARTH SATELLITE OBSERVATIONS OF THE IONOSPHERE. See Abstr. 7682

529.786

7750. ACCURACY OF THE STARK MODULATION SYSTEM ATOMIC CLOCK. T.Ogawa.
Doshisha Engng Rev., Vol. 6, No. 4, 165-72 (Jan., 1956).

The Stark modulation system atomic clock is able to be driven for a long period of time. The accuracy of this clock is calculated to be better than $\pm 5 \times 10^{-9}$, in spite of the rather broad half-width and the anomalous dispersion of the absorption line, and the error of the Stark field. The error of the clock is so much smaller than the variations in the earth's rotation, which is now used as the time standard of the mean solar day, that the clock is able to decide the "atomic standard time". The sensitivity of the discrimination character of the absorption line modulated by the Stark field is also discussed, and the sensitivity is sufficient to realize the accuracy mentioned above.

529.786

7751. ACCURACY OF THE STARK MODULATION ATOMIC CLOCK. II. T.Ogawa.
Doshisha Engng Rev., Vol. 7, No. 2, 166-71 (Sept., 1956).

Errors of the Stark modulation atomic clock which must be considered for a long period of operation are discussed in detail. These errors are caused by the variations of the pressure of ammonia gas, of the impedances of the crystal frequency multiplier and the detector, and of the waveform of the Stark modulation. In order to maintain the accuracy of the atomic clock at better than 5×10^{-9}, the pressure variation must be kept within 2×10^{-1} at the pressure of 4×10^{-3} mm Hg, and the rise and fall times of the Stark waveform less than 1 µsec. The errors caused by the variation of the impedances can be neglected when uniguides of inverse loss 20 dB are used.

PHYSICS

GENERAL

530.1

7752. EMPIRICAL GRAVITATIONAL EQUATION. R.Weinstein.
Amer. J. Phys., Vol. 25, No. 9, 650 (Dec., 1957).

The author uses the fortuitous empirical relationship $Tg = c$, where T is the period of the earth round the sun (1 year), g is the acceleration of gravity (980 cm/sec^2) and c is the velocity of light, to illustrate the fallacies which may arise by attempting to interpret such accidental equalities. E.G.Knowles

GRAVITATION . RELATIVITY

530.12

7753. CONTRIBUTION TO THE PROJECTIVE THEORY OF RELATIVITY. II. E.Schmutzer.
Z. Phys., Vol. 154, No. 3, 312-18 (1959). In German.

For previous part, see Abstr. 4700 (1958). Further consideration is given to the physical interpretation of the modified theory. Results concerning a scalar matter field, the field of a point mass and applications to cosmology are briefly considered.
R.A.Newing

530.12

7754. PHYSICAL CONSEQUENCES OF A UNIFIED THEORY.
J.M.Souriau.
C.R. Acad. Sci. (Paris), Vol. 248, No. 10, 1478-80 (March 9, 1959).
In French.

In a further development of the author's theory (Abstr. 2030 of 1959), the Lorentz group is replaced by a new group in 5-space. The algebraic properties of this group lead to the introduction of integral values of electric charge, gauge transformations, parity and the existence of antiparticles. R.A.Newing

530.1

7755. PRINCIPLE OF A UNIFIED THEORY. INTERPRETATION BASED ON THE USE OF A FIBRE SPACE. M.Lenoir.
C.R. Acad. Sci. (Paris), Vol. 248, No. 13, 1944-6 (April 1, 1959).
In French.

Introduction of a fibre space in a differential variety V_n permi the definition of a generalized curvature tensor. These results are applied to the study of a unified theory in the case $n = 4$.
T.R.Carso

530.1

7756. ON THE CONNECTION OF FIELD-DEPENDENT PROPER MASS WITH CONFORMAL MINKOWSKI SPACE. C.Jankiewicz.
Bull. Acad. Polon. Sci. Ser. Sci. math. astron. phys., Vol. 6, No. 12 765-9 (1958). In German.

It is shown that the equations of motion of a point mass, whose rest mass varies with position in a field of force, define a geodesic in conformal Minkowski space—time. R.A. Newi

530.

7757. INTRODUCTION OF A TENSOR OF THE FOURTH RANK.
L.Bel.
C.R. Acad. Sci. (Paris), Vol. 248, No. 9, 1297-300 (March 2, 1959).
In French.

A tensor of the fourth rank having the symmetry properties

$$T^{\alpha\beta,\lambda\mu} = T^{\beta\alpha,\lambda\mu} = T^{\alpha\beta,\mu\lambda} = T^{\lambda\mu,\alpha\beta}$$

is introduced and shown to be equal, when $R_{\alpha\beta} = \lambda g_{\alpha\beta}$, to a tensor encountered in the study of gravitational radiation (Abstr. 1020 of 1959). T.R.Cars

530.

7758. EQUATIONS OF MOTION AND GRAVITATIONAL RADIATION. L.Infeld.
Ann. Phys. (New York), Vol. 6, No. 4, 341-67 (April, 1959).

Considers whether a system of gravitational masses radiates energy. An attempt is made to define gravitational radiation in a simple way. Its total flux equals the time derivative of the gravitational linear momentum. Then the principal question arises whether or not this gravitational linear momentum is constant. T question, when properly formulated, is intimately connected with the problem of the motion of particles in their gravitational field. This connection traced: one returns ultimately to the principal question. The answer is: a reasonable coordinate system, in which there is no gravitational radiation, can always be found.

530.12

7759. TENSOR FIELD OF A ROTATING FLUID MASS. P.Dive.
Arch. Sci. (Geneva), Vol. 11, No. 4, 403-56 (Oct.-Dec., 1958).
In French.

A detailed investigation is made of the gravitational field, both internal and external, due to the slow rotation of a mass of low density constituting a perfect fluid endowed with internal pressure. Much attention is given to the general form of the line element and its dependence on the angular velocity, ω. Results are obtained both for the rotating mass and for the case when the mass is at rest ($\omega = 0$) and their relation to those of other investigators is discussed at length. T.R.Carson

530.12

7760. CONCEPT OF INTERNAL MOVEMENT IN ROTATING RELATIVISTIC FLUID MASSES. M.Kléman.
C.R. Acad. Sci. (Paris), Vol. 248, No. 11, 1617-20 (March 16, 1959).
In French.

By introducing, in addition to the centre of mass, a "centre of matter" defined with respect to a given hyperplane as the first moment of the current density, the expression for the energy of rotation of a relativistic fluid takes a very simple form. For the movement of the centre of mass around the centre of matter in the given hyperplane the rotational energy is shown to be proportional to the angular frequency of the relative motion. T.R.Carson

530.12

7761. CONSERVATION CONDITIONS IN THE PERFECT FLUID SCHEMA FOR THE JORDAN–THIRY THEORY. A.Surin.
C.R. Acad. Sci. (Paris), Vol. 248, No. 10, 1476-8 (March 9, 1959).
In French.

See Abstr. 3099 (1959).

530.12

7762. ON HYDRODYNAMICS IN THE JORDAN–THIRY THEORY. R.Vallée.
C.R. Acad. Sci. (Paris), Vol. 248, No. 12, 1779-81 (March 23, 1959).
In French.

An attempt is made, within the framework of the Jordan–Thiry unified theory, to extend to the case of a perfect fluid certain results obtained in the case of the pure matter field. T.R.Carson

530.12

7763. CONTINUITY CONDITIONS AND SHOCK EQUATIONS. Y.Fourès-Bruhat.
C.R. Acad. Sci. (Paris), Vol. 248, No. 12, 1782-4 (March 23, 1959).
In French.

In the case of a discontinuous energy–momentum tensor the "shock" equations at the discontinuity follow from the Bianchi dentities. These equations are then applied to the study of shocks n charged perfect fluids with infinite conductivity. T.R.Carson

530.12

7764. STUDY OF A WEYSSENHOFF FLUID IN AN ELECTROMAGNETIC FIELD. R.Bkouche.
C.R. Acad. Sci. (Paris), Vol. 248, No. 12, 1788-90 (March 23, 1959).
n French.

A conservation equation is derived for a Weyssenhoff fluid in a magnetic field, the polarization density being assumed proportional o the spin density. O.Penrose

530.12 : 538.3

7765. THE PRINCIPLES OF ELECTROMAGNETIC THEORY AND RELATIVITY. M.A.Tonnelat.
Paris: Masson et Cie (1959), 394 pp. In French.

This work gives a simple presentation of the fundamentals of electromagnetic theory, special relativity and general relativity. The aim of the book, which is suitable for readers at the graduate evel, is to lay emphasis on the path of development and the experimental verification of these theories. The text is divided into four parts. The first, comprising chapters I to IV, recalls the fundamen- al principles of electrostatics, magnetostatics, electromagnetism and deals with some of the early work on electrodynamics. The second part (chapters V to X) is devoted to the development of special relativity. Beginning with the principle of relativity before Einstein, the development is traced to the theory of 1905. The four-dimensional formalism is then introduced and applied successively in the fields of kinematics, dynamics and electromagnetism. Finally, the chief consequences of the theory are examined and an account given of the usual experimental evidence for its validity. The third part of the book (chapters XI to XII) is given to an exposition of the principles of general relativity. The approach may be described as logical rather than axiomatic. Particular significance is attached to the principle of equivalence which forms the bridge between the special and the general theories. The essential development of general relativity then follows together with a study of its consequences and their now classical confirmation. This part of the work concludes with a brief non-mathematical discussion of the unified field theories of electromagnetism and gravitation. The last two chapters, constituting the fourth part of the book, take the form of a mathematical appendix dealing with the tensor calculus of a Euclidean space, an affinely connected space and, in particular, a space characterized by a Riemannian metric. The text is well supplied with references to the literature and there is a comprehensive bibliography at the end. A number of problems, some with solutions, are provided. T.R.Carson

530.12

7766. ELECTROMAGNETIC AND GRAVITATIONAL WAVES IN GENERAL RELATIVITY. A.Lichnerowicz.
Cahiers de Phys., Vol. 12, 287-96 (Aug., 1958). In French.

Recent studies relating to the definition of the existence of gravitational waves are reviewed. The analogy between the electromagnetic and gravitational fields is emphasized, the wave front in each case being a "characteristic" of the appropriate field equations. In the latter case it is pointed out that the form of these equations suggests a process of quantization analogous to that carried out for the former. T.R.Carson

530.12 : 538.3

7767. ELECTROMAGNETIC INDUCTION IN GENERAL RELATIVITY. Pham Mau Quan.
Cahiers de Phys., Vol. 12, 297-307 (Aug., 1958). In French.

A state of electromagnetic induction is defined in a domain of the four-dimensional continuum. The characteristic cones of the Maxwell equations then determine an associated metric whose null geodesics represent light rays in the refracting medium. The usual relation, $n = \sqrt{\epsilon\mu}$, between the refractive index n, the dielectric strength ϵ and magnetic permeability μ is recovered. T.R.Carson

530.12 : 536.7

7768. ON RELATIVISTIC THERMODYNAMICS. N.L.Balazs.
Astrophys. J., Vol. 128, No. 2, 398-405 (Sept., 1958).

Derives the conditions for thermal equilibrium in the presence of gravitational fields using relativistic mechanics and the orthodox methods of thermodynamics.

530.12

7769. THE ROLE OF ISOTHERMAL CONDITIONS IN GENERAL RELATIVITY. F.Hennequin.
Cahiers de Phys., Vol. 12, 308-10 (Aug., 1958). In French.

An isothermal coordinate system is defined as one whose coordinate surfaces are $f^\lambda(x)$ = constant, where the $f^\lambda(x)$ are four independent solutions of the generalized wave-equation:

$$\nabla_\alpha(\partial^\alpha f) = \nabla_\alpha(g^{\alpha\beta}\partial_\beta f) = g^{\alpha\beta}(\partial_{\alpha\beta} f - \Gamma^\rho_{\alpha\beta}\partial_\rho f = 0.$$

The use of such a system of coordinates is illustrated by application to several problems. T.R.Carson

530.12

7770. CHOICE AND INTERPRETATION OF COORDINATE SYSTEMS IN GENERAL RELATIVITY. S.Kichenassamy.
Cahiers de Phys., Vol. 12, 311-16 (Aug., 1958). In French.

Since the results of measurements are necessarily relative to the local coordinate system adopted, problems in interpretation arise when one wishes to deduce spatio–temporal properties from the observations. To escape these difficulties the method of infinitesimal transformations, based on the concept of the Lie derivative, is proposed. By way of illustration, the method is applied to the case of the Einstein–Friedmann metric, showing that Hubble's law follows naturally from the generalized Doppler effect. T.R.Carson

530.12

7771. THE LANGUAGE OF RELATIVITY AND PHYSICAL REALITY. D.Faggiani.
Ingegnere, Vol. 33, No. 3, 199-203 (March, 1959). In Italian.

530.12

7772. THE CLOCK PARADOX. C.C.MacDuffee.
Science, Vol. 129, 1359 (May 15, 1959).

In two-dimensional Minkowski space a geodesic arc is longer than every other admissible arc with the same end points. Thus a particle whose world-line is a geodesic — that is, an unaccelerated particle — requires more (local) time to travel between two events than an accelerated particle. Similar results in four-dimensional Minkowski space can be established.

530.12

7773. CAN ONE DERIVE THE SCHWARTZSCHILD LINE-ELEMENT WITHOUT THE FIELD EQUATIONS? N.L.Balazs.
Z. Phys., Vol. 154, No. 2, 264-6 (1959).

Using only the Principle of Equivalence and the conservation of energy, the Schwartzschild line element is derived, for weak gravitational fields, without the use of Einstein's field equations, as was first shown by Lenz in 1944. Criticism by Kohler of Lenz's derivation is discounted. T.R.Carson

FIELD THEORY . QUANTUM THEORY

530.145

7774. POSSIBLE PARITY ASSIGNMENTS FOR THE STRANGE PARTICLES. J.G.Taylor.
Nuclear Phys., Vol. 9, No. 3, 357-70 (Jan. (1), 1959).

A general method is described which enables parities and coupling constants to be determined from angular distributions for strange particle processes. In particular, from associated production of Λ and Σ particles by pions the relative parity of K^+ to K^0 seems quite conclusively to be odd, while the data are fitted best by K^+ having odd parity with respect to both the (ΛN) and the (ΣN) systems. Some inequalities between combinations of various coupling constants are also derived.

530.145 : 539.12

7775. PARITY NON-CONSERVATION AND THE ALGEBRA OF ELEMENTARY PARTICLES. K.Sekine.
Nuclear Phys., Vol. 11, No. 3, 604-14 (June (1), 1959).

An attempt is made to incorporate the phenomenological expression $\mathrm{Re}(C^*C')\neq 0$ for the observed non-conservation of parity into the property of the algebra of elementary particles, and to reconstruct the theory on the basis of the new algebra, which is now characterized by the non-unitarity of representation for the improper Lorentz group.

530.145 : 530.162

7776. ON THE QUANTUM THEORY OF MEASUREMENT. A.Landé.
Z. Phys., Vol. 153, No. 4, 389-93 (1959). In German.

The Heisenberg—von Neumann description of the measuring process is based on a double meaning of the term "state" and on a misinterpretation of the Schrödinger equation, leading to a mixture of subjective and objective elements. The situation can be remedied by consistently accepting the statistical interpretation thus eliminating the double meaning and removing intrinsic contradictions from the theory of measurement. T.R.Carson

530.145

7777. QUANTUM MECHANICS AND GEOMETRY. IV. M.Schönberg.
An. Acad. Brasil. Cienc., Vol. 30, No. 3, 259-80 (1958).

For Pt III, see Abstr. 3108 (1959). See also following abstract.

530.145

7778. QUANTUM MECHANICS AND GEOMETRY. V. M.Schönberg.
An. Acad. Brasil. Cienc., Vol. 30, No. 4, 429-46 (1958).

Final paper of series.

530.145

7779. ON THE EQUIVALENCE OF A CERTAIN CLASS OF NON-LOCAL AND HIGHER ORDER FIELD THEORIES.
K.L.Nagy and J.Rzewuski.
Bull. Acad. Polon. Sci. Ser. Sci. math. astron. phys., Vol. 7, No. 2, 93-6 (1959).

It is shown that a certain class of non-local field theories is equivalent to field theories with higher order Lagrangians, provided that in the Hilbert space of the latter Bogolyubov's prescriptions are applied. The equivalence is demonstrated in the case of the non-local interaction of a neutral scalar field and a complex scalar field. T.R.Carson

530.145

7780. NON-LOCAL STRUCTURE OF QUANTIZED FIELD THEORIES OF THE SECOND KIND. W.Güttinger.
Nuclear Phys., Vol. 9, No. 3, 429-36 (Jan. (1), 1959).

The transcendental vacuum expectation values arising from quantized field theories of the second kind are shown to impart to those theories a non-local structure which is characterized by an indeterminacy in space—time of the light cone, an indefinite metric in Hilbert space and non-invariance under similarity transformations in space—time.

530.145

7781. SCHEME OF QUANTUM MECHANICS WITH INDEFINITE METRIC. A.Uhlmann.
Nuclear Phys., Vol. 9, No. 4, 588-95 (Jan. (2), 1959). In German.

The problem is examined how to change the axioms of quantum theory in order to introduce an indefinite metric. There are several inequivalent ways to divide the total Hilbert space of indefinite metric into two parts, one of which is of positive definite, the other of negative definite metric (so-called "physical" and "ghost-states"). In view of arbitrariness in the choice of such decompositions the question is raised whether the completeness of the quantal description only requires the knowledge of the state-vectors and the hermitian operators belonging to the observables, or whether it is necessary to have further knowledge in order to privilege one mode of decomposition of the space into a positive and a negative part. The second suggestion is denied. Every commuting system of hermitian operators points to a definite decomposition in a natural way, provided it is "large enough". One calls "decomposing" every system of commuting operators which divides (in a certain sense) the total Hilbert space into a positive and a negative part. Not only does a decomposing system induce the decomposition, but there is associated with it a new positive definite metric of the total space. In this way a probabilistic interpretation is valid and the usual axiomatics is applicable. With respect to decomposing systems which induce the same decomposition, all results belonging to a quantum theory with positive definite metric are conserved. But there exists another case: the hermitian operator A may belong simultaneously to two decomposing systems $\mathfrak{G}_1$ and $\mathfrak{G}_2$ and the decomposition relative to $\mathfrak{G}_1$ may not agree with the decomposition relative to $\mathfrak{G}_2$. Then, when analysing a quantum state with the help of observables represented by operators belonging to $\mathfrak{G}_1$, one may find an expectation value $\bar{A}^{(1)}$ different from the expectation value $A^{(2)}$ of A with respect to an experiment that determines (in principle) the $\mathfrak{G}_2$-observables.

530.145

7782. SOME RESULTS ON ANALYTIC FUNCTIONS IN LOCAL FIELD THEORY. D.J.Kleitman.
Nuclear Phys., Vol. 11, No. 2, 459-65 (May (3), 1959).

Lorentz invariance, local commutativity, and the absence of negative mass states imply that the vacuum expectation value and the Fourier transform of the retarded commutator of a product of field operators are boundary values of analytic functions. The cases of four and five local scalar fields are investigated in the spirit of the approach of Källen and Wightman (Abstr. 32 of 1958). It is shown that the domain of analyticity of the vacuum expectation value in x-space contains that of the retarded commutator in p-space. A computation of the real points of these domains is discussed.

530.145 : 512.9

COUPLING OF FIELDS. NUMBER OF INDEPENDENT SCALAR DETERMINED BY TENSOR QUANTITIES. See Abstr. 7717

530.145

7783. THE ELECTRON OF THE UNIVERSAL FERMI INTERACTION. L.M.Garrido Arilla and P.Pascual de Sans.
An. Real Soc. Espan. Fis. Quim., Vol. 55(A), No. 1-2, 5-12 (Jan.-Feb., 1959). In Spanish.

A canonical formulation of the two-component representation of Fermi particles proposed by Feynman and Gell-Mann (Abstr. 507/1958). R.A.Newing

530.145

784. ON THE LEE MODEL. I.Białynicki-Birula.
ull. Acad. Polon. Sci. Ser. Sci. math. astron. phys., Vol. 7, No. 2,
7-83 (1959).

Local quantum field theory is used to describe two fermion elds (the fermions are infinitely heavy) in interaction with the oson field. There is no difficulty connected with the renormalizaon and the unrenormalized and renormalized coupling constants re equal. In the Lee model, it is shown that the characteristic difculties, necessitating the introduction of an indefinite metric, arise rom the lack of symmetry between the creation and annihilation of osons and due to the removal of certain terms from the interaction amiltonian. T.R.Carson

530.145

785. ON CHARGE CONJUGATION AND TWO ANALOGOUS RANSFORMATIONS. J.Winogradzki.
.R. Acad. Sci. (Paris), Vol. 248, No. 10, 1480-3 (March 9, 1959).
French.

Using the eight second-rank spinors, whose components are variant with respect to transformations of the general Lorentz roup, as operators it is shown that every spinor of the second rank an element of a set of four spinors of the same variance. Every ouple in this set is connected by relations which, in the particular ase of the Dirac field, correspond to changes of sign of charge, ass or both. T.R.Carson

530.145

786. UNRENORMALIZABLE INTERACTIONS AND THE TRUCTURE OF ELEMENTARY PARTICLES.
.Strathdee and Y.Takahashi.
uclear Phys., Vol. 9, No. 3, 558-60 (Jan. (1), 1959).

A possible relation of the unrenormalizable interactions to the ternal structure of elementary particles is approached with the elp of a simple model. A non-local, charge-independent, and CP combined) invariant interaction is examined and a simple connection found to emerge between the problems of parity violation in weak teractions and the divergence of self-energy. The connection involves a supposed universal fundamental length.

530.145 : 539.12

787. ON THE ELECTRON–MUON MASS DIFFERENCE.
Saavedra.
uclear Phys., Vol. 11, No. 3, 569-73 (June (1), 1959).

On the basis of a previously developed formalism (Abstr. 6516 1959) it is shown that a hypothetical (uncharged) boson isoscalar ould remove the electron–muon mass degeneracy.

530.145

788. PAIS DOUBLETS AND THE UNIVERSAL FERMI INTERCTION. J.C.Polkinghorne.
uclear Phys., Vol. 11, No. 3, 599-603 (June (1), 1959).

A universal Fermi interaction responsible for all weak decays investigated in terms of Pais's doublet representation of baryons bstr. 3704 of 1958). Some understanding may be gained of the pparently anomalous hyperon-leptonic decays and some of the consequences of the $\Delta I = \frac{1}{2}$ rule are simulated. One of the two alterative schemes proposed would lead to a direct decay mode for Ξ articles into nucleons and pions.

530.145 : 539.12

π—e DECAY AND THE UNIVERSAL INTERACTION.
e bstr. 7275

530.145 : 539.12

RADIATIVE CORRECTIONS TO FERMI INTERACTIONS.
e Abstr. 7278

530.145

789. A SYSTEM OF NON-LINEAR WAVE-EQUATIONS GENRALIZING THE EQUATIONS OF THE THEORY OF THE SPIN-$\frac{1}{2}$ ARTICLE. G.Petiau.
.R. Acad. Sci. (Paris), Vol. 248, No. 11, 1620-2 (March 16, 1959).
French.

Equations are given which represent both a spin-$\frac{1}{2}$ particle and associated vector field: a development of earlier work (Abstr. 33 of 1958). R.J.N.Phillips

530.145

790. SPIN-$\frac{1}{2}$ PARTICLES AS SEMI-SPINORS OF A SIXIMENSIONAL SPACE, AND PARITY CONSERVATION. G.Allard.
.R.Acad. Sci. (Paris), Vol. 248, No. 16, 2288-90 (April 20, 1959).
French.

Parity nonconservation in Minkowski space is taken to indicate that elementary particles are better represented in a space of more dimensions. The case of six dimensions is studied.

R.J.N.Phillips

530.145

7791. ON THE TWO DIMENSIONAL THIRRING MODEL.
M.É.Maier and D.V.Shirkov.
Dokl. Akad. Nauk SSSR, Vol. 122, No. 1, 45-7 (1958). In Russian.

Following Thirring (Abstr. 2758 of 1958), a spinor field theory in one space and one time dimension is considered, with a self-interaction proportional to $\bar{\psi}\psi\bar{\psi}\psi$. The S-matrix for the scattering of two zero-mass ψ-particles is found in second-order perturbation theory, and is then extended by the method of the renormalization group to give an expression which is strictly valid in the weak coupling limit, without restriction on the momentum transfer. The result is quoted as a counter-example to the claims of Konuma and Umezawa (Abstr. 1890 of 1957) concerning the high energy limit.

G.P.McCauley

530.145

7792. THE NUMBER OF INVARIANTS FORMED FROM $2l$ DIRAC SPINORS. M.Fierz.
Helv. phys. Acta, Vol. 31, No. 6, 587-90 (1958). In German.

Pauli's result for four spinors (five scalars and five pseudoscalars) is obtained with the help of spinor calculus, and a simple formula is derived for the general case. W.A.Hepner

530.145 : 538.3

SOLUTION OF MAXWELL'S EQUATIONS IN TERMS OF A SPINOR NOTATION: THE DIRECT AND INVERSE PROBLEM.
See Abstr. 7206

530.145

7793. DIAGONALIZATION OF HAMILTONIAN.
L.M.Garrido and P.Pascual.
Nuovo Cimento, Vol. 12, No. 3, 181-90 (May 1, 1959).

A general method is given for diagonalizing the Hamiltonian of particles of arbitrary spin. Cases of spin 0, $\frac{1}{2}$, 1 are studied in particular and it is shown that for spin $\frac{1}{2}$ the transformation agrees with Foldy's and the expression for different observables for particles of spin 0 and 1 is obtained in the new representation.

530.145

7794. CHARGE SYMMETRY PROPERTIES AND REPRESENTATIONS OF THE EXTENDED LORENTZ GROUP IN THE THEORY OF ELEMENTARY PARTICLES.
V.I.Ogievetsky and Chou Kuang-Chao.
Nuclear Phys., Vol. 10, No. 3, 235-43 (March, 1959).

The extended Lorentz group, which includes the complete Lorentz group and the charge conjugation operation, is considered. It i shown that use of irreducible projective representations of the extended group requires the existence of charge multiplets. Charge symmetry and pair production of strange particles follow from invariance under reflections and charge conjugation and from the laws of conservation of electric and baryon charges. The Pauli—Gürsey transformation is valid for free nucleons. The requirements of invariance under this transformation in the case of interaction also leads to isobaric invariance for all particles in strong interactions.

530.145

7795. THEORY OF DIRAC PARTICLES WITH ORIENTED SPINS AND PARITY NON-CONSERVATION. A.A.Sokolov.
Nuclear Phys., Vol. 9, No. 3, 420-5 (Jan. (1), 1959).

The Lüders—Pauli theorem is investigated in connection with a type of theory chosen to describe Dirac particles with oriented spins.

530.145

7796. ON THE SECOND ORDER WAVE EQUATION OF FERMIONS. II. G.Marx.
Nuclear Phys., Vol. 10, No. 4, 468-74 (April (1), 1959).

For Pt I, see Abstr. 2074/1959. A new space reflection P' and charge conjugation C' can be readily introduced from the second-order wave-equation for fermion doublets. Strong as well as weak interactions are invariant with respect to P' and C' while electromagnetic interactions show only P'C' invariance. The wave operator for the nucleon (and for other fermion doublets) is the irreducible representation of the Lorentz group extended by P' and C'. Results obtained by this theory and by that of Gell—Mann disagree only as to decay of strange particles.

530.145

7797. ON THE ORDERED-EXPONENTIAL SOLUTIONS FOR THE THIRRING MODEL. F.L.Scarf.
Nuclear Phys., Vol. 11, No. 3, 475-8 (May (3), 1959).

The explicit solutions for the Thirring model (Abstr. 2758 of 1958) obtained by Glaser (Abstr. 2065 of 1959) and by Pradhan (Abstr. 1067 of 1959) are shown to be equivalent when the latter is defined by a suitable limiting process. It is found that they lead to identical expressions for the wave-function renormalization constant and for the invariant Green's function.

530.145 : 539.12

ANGULAR DISTRIBUTION OF THE DECAY PRODUCTS OF A PARTICLE OF ARBITRARY SPIN. See Abstr. 7239

530.145

7798. JOST FUNCTIONS AND DISPERSION RELATIONS. J.J.Giambiagi and T.W.B.Kibble.
Ann. Phys. (New York), Vol. 7, No. 1, 39-51 (May, 1959).

The functions were discussed by Jost (Abstr. 30 of 1948) in connection with the solution of the nonrelativistic Schrödinger equation. They are identical with the complex determinantal function, discussed by Baker (Abstr. 1667 of 1959) and extended to field theory. Their properties are summarized and discussed, and some applications are described. It is argued that if some additional relation were obtained, which made it possible to solve the dispersion relations for them, this formalism might have distinct advantages over that in terms of dispersion relations for the scattering amplitude. In particular, the difficulties associated with the Castillejo—Dalitz—Dyson ambiguity would no longer appear. Moreover, it is suggested that there may be a useful application to the correct description of bound states in scattering theory.

530.145 : 539.12

DISPERSION RELATIONS FOR VIRTUAL PHOTOPRODUCTION. See Abstr. 7248-9

530.145

7799. EQUATIONS FOR THE GREEN'S FUNCTIONS AND THE VACUUM FUNCTIONAL IN THE PAIR THEORY.
Yu.M.Lomsadze and B.I.Maksimov.
Bul. Inst. Politeh. Iasi, Vol. 4(VIII), No. 1-2, 121-6 (1958).
In Russian.

Schwinger's variational method is applied to the nonlinear pair theory of interaction between the spinorial nucleon field and the real pseudoscalar meson field. The equations for the nucleon- and meson-Green's functions and for the vacuum functional are found, and the solution of the latter is given in the form of a functional integral. P.Roman

530.145

7800. A NEW PROOF OF THE DIRAC THEOREM. Yu.I.Kulakov.
Czech. J. Phys., Vol. 7, No. 4, 504-5 (1957). In Russian.

Using the properties of spherical harmonics, a new and more rigorous proof is given of Dirac's theorem (1935) which gives the condition the wave-function in momentum space must satisfy in order to have outgoing waves only in coordinate space. P.Roman

530.145 : 539.12

7801. BOUND STATES IN MESON PAIR THEORY (A POSSIBLE PHYSICAL MODEL OF HYPERONS). G.Györgyi.
Nuclear Phys., Vol. 10, No. 2, 197-202 (Feb. (2), 1959).

Bound states in meson pair theory are investigated in the strong cut-off lattice space approximation of Wentzel, under the assumption of a vector coupling. The problem under consideration may serve as a model field theory of the "$N\bar{K}$" hyperon model suggested independently by Goldhaber (Abstr. 3253/1956) and the author (Abstr. 6590/1957).

530.145 : 539.12

7802. ON THE PROOF OF DISPERSION RELATIONS FOR INELASTIC SCATTERING. A.A.Logunov and I.T.Todorov.
Nuclear Phys., Vol. 10, No. 5, 552-63 (April (2), 1959).

A derivation of dispersion relations for the inelastic process ($p + \pi \rightarrow p' + \pi' + \pi''$) is presented based on a theorem of analytic continuation. The one-nucleon terms are correlated with the amplitudes of simpler processes.

530.145

7803. THE POLES OF THE S-MATRIX OF A RECTANGULAR POTENTIAL WELL OR BARRIER. H.M.Nussenzveig.
Nuclear Phys., Vol. 11, No. 3, 499-521 (June (1), 1959).

To test the validity of current ideas on the poles of the S-matrix, a simple example is treated: non-relativistic scattering by a spherically symmetric rectangular potential well. The poles of the S-matrix associated with this problem, in the case of zero angular momentum, are determined, and their behaviour as a function of the well depth (barrier height) is discussed. Some results for higher angular momenta are also given. The usual physical interpretation may be applied only to a very restricted class of poles. Difficulties appear in the case of "short-lived decaying states". However, the present model leads to a connection between the limiting cases of strongly bound states in a deep well and of certain characteristic states attached to a "hard sphere" or to a perfect conductor (antenna It is shown that some poles, previously described as "meaningless", give rise to important physical effects.

530.145

7804. RELATIVISTIC WAVE EQUATIONS FOR SPIN-2 PARTICLES WITH UNIQUE MASS. O.Brulin and S.Hjalmars.
Ark. Fys., Vol. 14, Paper 4, 49-60 (1958).

Extension of Abstr. 48 (1958). Linear equations, in which the mass term is not simply a multiple of the unit matrix, are studied. A suitable choice gives a unique mass. R.J.N.Phillips

530.145

7805. ON A NON-LINEAR SYSTEM OF WAVE-EQUATIONS DESCRIBING A MODEL PARTICLE-FIELD OF SPIN 0 AND $\hbar$.
G.Petiau.
C.R. Acad. Sci. (Paris), Vol. 248, No. 8, 1129-32 (Feb. 23, 1959).
In French.

Studies a system of non-linear first-order partial differential equations which describe both a field and its source particles, the linear reductions of the theory being wave-equations for particles of spin 0 and $\hbar$. J.C.Taylor

530.14

7806. STATISTICAL MEANING OF THE AMPLITUDES IN THE WAVE MECHANICS OF SYSTEMS. J.Andrade e Silva.
C.R.Acad. Sci. (Paris), Vol. 248, No. 16, 2291-3 (April 20, 1959).
In French.

Deals with the generalization of a statistical theorem, proved by Bohm and Vigier (Abstr. 10778 of 1954) for the case of one particle. J.Lascou

530.14

7807. ON THE RELATION BETWEEN THE S-MATRIX AND POTENTIAL FOR THE ONE-DIMENSIONAL SCHRÖDINGER OPERATOR. L.D.Faddeev.
Dokl. Akad. Nauk SSSR, Vol. 121, No. 1, 63-6 (July 1, 1958).
In Russian. English translation in : Soviet Physics — Doklady (New York), Vol. 3, No. 4, 747-51 (July-Aug., 1958).

The author considers what properties the S-matrix must posse so that the corresponding potential $q(x)$ satisfies the usual integrability conditions, namely that the integral of $(1 + |x|)\ |q(x)|$ over the entire x-axis be finite. If F_1 and F_2 are the Fourier transforms of the elements of S, namely s_{11} and s_{22} respectively, then F_1' and F_2' (derivatives) should satisfy integrability conditions, similar to those of q. Having postulated this, together with the usual dependen of $s_{ij}(k)$ on the eigenvalue k (as stated in a lemma), the author show that then the unitary matrix $S(k)$ is the S-matrix of one-dimensional Schrödinger operator. The potential is then determined uniquely if, in addition to the S-matrix, n arbitrary positive numbers are given where n is the number of discrete eigenvalues.

J.K.Skwirzynsk

530.14

7808. ON THE SPECTRUM OF THE SCHRÖDINGER OPERATOR G.M.Zhislin.
Dokl. Akad. Nauk SSSR, Vol. 122, No. 3, 331-4 (Sept. 21, 1958).
In Russian.

The properties of the spectrum of the non-relativistic Schrödinger operator (quantum mechanical Hamiltonian) of a system of particles interacting through inverse square-law forces, are examined. In particular, the existence of a lowest eigenvalue is established. P.K.Kab

530.14

7809. ON THE EMISSION OF LOW ENERGY PHOTONS FROM A QUANTIZED SYSTEM. R.Ascoli.
Nuovo Cimento, Vol. 12, No. 3, 192-217 (May 1, 1959).

The problem of the emission of photons from a general quantiz system is solved for the case when the reaction of the photons on the system is neglected. Till now this problem had been solved only in the case of the emission from a classical system. A gener expression is deduced for the average number of photons which are emitted when a time dependent perturbation produces a transition between two arbitrary states of the system. The discussion of this expression leads to the conclusion that the average number of low energy photons emitted in any experiment which can really be done is finite: this conclusion generalizes a result previously obtained by the author in the case of a classical source to the case of quantized source. Moreover, neglecting the reaction of the photons on the charges, it is shown that the average number of emitted photons is equal to the first term of the expansion in powers of e of the emission probability of one photon. The application of this conclusion to the case of a transition between two definite momentum states shows that the Bloch—Nordsieck divergence and the infrared divergence of the perturbative calculation have their origin in the divergence of the same mathematical expression, although they have an entirely different physical meaning. Finally it is shown that the problem studied here in general has no meaning in the case of a time independent perturbation.

530.145

7810. PARTIAL WAVE ANALYSIS OF THE PRODUCTION OF BOSON PAIRS. S.Ciulli and J.Fischer.
Nuovo Cimento, Vol. 12, No. 3, 264-85 (May 1, 1959).

Partial wave analysis for boson pair production on nucleons is made. The corresponding angular operators, which characterize the spin and angular dependence of the S-matrix, are expressed with the help of the Legendre polynomials and tabulated. Simultaneously a general method of calculating the angular operators is given for processes containing more than four particles, in which cases the straightforward method leads to very lengthy calculations.

STATISTICAL MECHANICS

TRANSFER PROCESSES

530.162

811. EQUIVALENCE BETWEEN THE TWO PRINCIPLES OF ETARDED ACTIONS AND OF INCREASING ENTROPY.
. Costa de Beauregard.
ahiers de Phys., Vol. 12, 317-26 (Aug., 1958). In French.

Every statistical deduction of the theorem of increasing entropy mplies, as a hypothesis, some specific form of the principle of etarded actions. On replacing Newtonian by wave mechanics as the asis of statistical mechanics, one may reinterpret von Neumann's heorem on irreversibility of the measuring process in quantum mechanics. T.R.Carson

530.162

812. STATISTICAL-MECHANICAL THEORY OF IRREVERSIBLE ROCESSES. II. RESPONSE TO THERMAL DISTURBANCE.
Kubo, M.Yokota and S.Nakajima.
Phys. Soc. Japan, Vol. 12, No. 11, 1203-11 (Nov., 1957).

For Pt I, see Abstr. 8437 (1957). The possibility is examined of iving rigorous expressions for kinetic coefficients, such as heat onductivity, diffusion constant and thermoelectric power, which elate the flow of a certain kind to the generalized forces of thermal ature. The fundamental assumption of Onsager is made — that the verage regression of spontaneous fluctuation of macroscopic variables follows the macroscopic physical laws. The kinetic coefficient $_{jl}$ appearing in the phenomenological equation $\dot{\alpha}_j = \Sigma G_{jl}(\partial S/\partial\alpha_l)$ is hown to be expressible as

$$G_{jl} = (k\beta)^{-1}\int_0^\infty d\tau\int_0^\beta \langle\dot{\alpha}_l(-ih\lambda)\alpha_j(\tau)\rangle d\lambda$$

here k is the Boltzmann constant and $\beta = 1/kT$. This is the same pe of formula as was found in Pt I for the kinetic coefficients for echanical disturbances. The theory is illustrated for the example electronic transport phenomena.

530.162

13. ANALYSIS OF THE LINEAR COOPERATIVE PROBLEM AS MARKOFF PROCESS. W.W.Mullins.
hys. Rev., Vol. 114, No. 2, 389-93 (April 15, 1959).

The equilibrium statistical structure of a linear chain of intercting elements, each capable of α states, is determined by utilizing he theory of the entropy of a Markoff process to express the free ergy of the chain as a function of its transition probabilities. Minimization of the free energy then leads to equations for the transition probabilities. The condition that these equations have a nontrivial solution permits the determination of the free energy from the largest eigenvalue of a certain matrix A, already familiar in the matrix method of cooperative phenomena. The corresponding eigenvector (together with the elements A_{ij}) is shown to determine the statistical structure of the chain. Previous discussion of the cooperative chain, in terms of a Markoff process, have been based on the assumption that the transition probabilities are given by normalized Boltzmann factors. This assumption is shown to be erroneous for most of the cases to which it has been applied.

530.162 : 539.14

7814. A SIMPLE INDEPENDENT-PARTICLE SYSTEM HAVING COLLECTIVE PROPERTIES. S.Goshen (Goldstein) and H.J.Lipkin.
Ann. Phys. (New York), Vol. 6, No. 4, 301-9 (April, 1959).

The motion of a system of particles in a one-dimensional harmonic-oscillator well is shown to have an alternative description involving collective vibrations. Collective variables are defined explicitly and the Hamiltonian is transformed to the collective representation. The equivalence of the collective and independent-particle descriptions is discussed both from a classical point of view and in terms of a group of transformations which can be used to classify the collective states. The possibility of extending the method to more general cases is discussed.

530.162 : 532.72

STATISTICAL MECHANICAL THEORY OF THERMAL DIFFUSION IN BINARY LIQUID SOLUTIONS. See Abstr. 6597

530.162 : 530.145

ON THE QUANTUM THEORY OF MEASUREMENT. See Abstr. 7776

530.19

7815. CONVERGENCE OF THE WICK–CHANDRASEKHAR APPROXIMATION TECHNIQUE IN RADIATIVE TRANSFER.
P.M.Anselone.
Astrophys. J., Vol. 128, No. 1, 124-9 (July, 1958).

Let $I(\tau, \mu)$ and $J(\tau)$ denote the intensity and average intensity in a semi-infinite, plane-parallel, purely isotropically scattering atmosphere with no incident radiation and constant net flux; and $I_m(\tau, \mu)$ and $J_m(\tau)$, $m \geq 1$, denote the Wick-Chandrasekhar approximations to $I(\tau, \mu)$ and $J(\tau)$ which are derived by means of either the Gauss or the "double Gauss" quadrature formula. As m increases, $I_m(\tau, \mu) \to I(\tau, \mu)$ and $J_m(\tau) \to J(\tau)$ uniformly for $0 \leq \tau \leq t$ and $-1 \leq \mu \leq 1$, where t is arbitrary.

530.19

7816. THE PROBABILITY METHOD FOR RADIATIVE TRANSFER PROBLEMS. MILNE'S PROBLEM WITH NONCOHERENT SCATTERING IN NON-CONSERVATIVE CASES. S.Ueno.
C.R.Acad. Sci. (Paris), Vol. 247, No. 17, 1314-16 (Oct. 27, 1958). In French.

An exact formal solution is given in this note, similar to that of Chandrasekhar for coherent scattering. G.A.Chisnall

530.19

7817. THE PROBABILITY METHOD FOR RADIATIVE TRANSFER PROBLEMS. TRANSMISSION AND DIFFUSE REFLECTION IN A FINITE ATMOSPHERE WITH NON-COHERENT SCATTERING.
S.Ueno.
C.R.Acad. Sci. (Paris), Vol. 247, No. 19, 1557-9 (Nov. 10, 1958). In French.

A preliminary note giving the explicit form of the laws of transmission and diffuse reflection in the above case. G.A.Chisnall

530.19

7818. EQUATION FOR RADIATIVE TRANSFER TAKING REFRACTION INTO ACCOUNT. I.N.Minin.
Optika i Spektrosk., Vol. 5, No. 3, 337-40 (1958). In Russian.
English Summary: PB 141047T-7, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

In radiative transfer theory it is usually assumed that the radiation quanta are propagated along straight lines between successive collisions. This assumption is valid only in media with constant refractive indices. For non-uniform media with variable refractive indices the transfer theory should allow for refraction. The author discusses the radiative transfer equation taking into account refraction in a plane layer. The paper is entirely theoretical.

GENERAL MECHANICS

MECHANICS OF SOLIDS

531.25 : 535.55

7819. STRAIN-OPTIC COEFFICIENT OF SILICON FOR INFRARED LIGHT. S.Prussin and A.Stevenson.
J. appl. Phys., Vol. 30, No. 3, 452-3 (March, 1959).

The coefficient was evaluated from measurements made on three bars cut from a silicon monocrystal grown in the <100> direction. These bars were subjected to pure bending and a wavelength of 1.2μ used. A value of 2.0 is obtained and the elastic compliance constants are tabulated. H.G.Jerrard

531.539.2

7820. COUPLED TORSION PENDULUMS. J.S.Miller.
Amer. J. Phys., Vol. 25, No. 9, 649-50 (Dec., 1957).

One method is described and others suggested for demonstrating the transfer of energy between coupled torsion pendulums.
E.G.Knowles

MECHANICAL MEASUREMENTS

531.715 : 535.417

INTERFEROMETER FOR LARGE SURFACES. See Abstr. 6784

531.715 : 535.417

INTERFEROMETER SUITABLE FOR THE MEASUREMENT OF END-STANDARD GAUGES. See Abstr. 6789

531.715 : 535.417

INTERFEROMETRIC MEASUREMENT OF METAL OXIDE FILMS. See Abstr. 6787

531.715 : 613.84 : 541.182

SIZE DISTRIBUTION OF TOBACCO SMOKE PARTICLES. See Abstr. 7583

531.715 : 541.182 : 551.575

DETECTION AND SIZE DETERMINATION OF VOLATILE AIRBORNE DROPLETS. See Abstr. 7692

531.721

7821. VIDEO DIFFERENTIAL PLANIMETER. M.Tobin.
Rev. sci. Instrum., Vol. 30, No. 5, 323-7 (May, 1959).

The video differential planimeter is an instrument which measures variations in the projected area of any remote object with the aid of a flying spot scanner or television camera system. The composite video signal, caused by the scanning of the object and its contrasting background, is shaped to yield a sequence of constant amplitude rectangular pulses that are negative going during a scan of the object, and positive going at all other times. The average of this sequence of pulses is obtained from a point on a bleeder resistance returned to the negative supply, and is fed into an integrator. The net integration voltage is read off and the integrator is returned to zero at the end of each field. If the object's projected area remains fixed, the sum of the positive and negative pulse areas entering the integrator will be constant. Hence, the change in integration voltage from field to field will be zero. If the object's projected area varies, the sum of the positive and negative pulses entering the integrator will change, and the read-out voltage of the integrator will vary proportionately. The instrument was applied to the measurement of the vibration of a speaker cone, and to the measurement of the human respiration and plethysmogram.

531.731 : 535.843

7822. DISCUSSION OF THE ERRORS IN THE DETERMINATION OF THE VOLUMES OF SMALL SPHERICAL BODIES OR LACUNAE FROM THE PROJECTED CROSS-SECTIONS. A.Hennig.
Z. wiss. Mikr., Vol. 63, No. 2, 67-71 (Sept., 1956). In German.

The purely geometrical theory of the errors in approximating the volume of a sphere by the sum of a number of short cylinders.
W.T.Welford

MECHANICS OF FLUIDS

532.5 : 533.6.011.311

7823. COMBINED FORCED AND FREE CONVECTION IN A BOUNDARY LAYER FLOW.
E.M.Sparrow, R.Eichhorn and J.L.Gregg.
Phys. of Fluids, Vol. 2, No. 3, 319-28 (May-June, 1959).

Consideration is given to the combined forced and free convection flow and heat transfer about a nonisothermal body subjected to a nonuniform free stream velocity. Similar solutions for the laminar boundary layer equations are found to exist when the free stream velocity and surface temperature vary respectively as x^n and x^{2n-1}. The parameter controlling the relative importance of the free and forced convection is Gr/Re^2. A flow separation phenomenon may occur when the forced and free convection act in opposite directions. Extensive numerical solutions of the transformed boundary layer equations have been carried out for the cases of uniform wall temperature and uniform wall heat flux for a Prandtl number of 0.7 (gases) over a wide range of values of Gr/Re^2. Results are reported for the heat transfer, shear stress, and velocity and temperature fields. Criteria are given for cataloguing flows as purely forced, purely free and mixed.

532.5

7824. FLUID MECHANICS OF COPPER.
W.A.Allen, H.L.Morrison, D.B.Ray and J.W.Rogers.
Phys. of Fluids, Vol. 2, No. 3, 329-33 (May-June, 1959).

Under pressure of sufficient magnitude, a metal such as copper can be considered to be an inviscid compressible fluid specified by an experimentally determined Hugoniot curve. This paper indicates the calculations necessary to solve the elementary problem of flow of an arbitrary fluid around an infinite wedge. The results are displayed in the form of graphs. A graphical solution is indicated for a problem involving impact of a conical projectile with a target. Agreement was obtained between the theoretical and experimental results.

532.5 : 541.12

HYDRODYNAMIC STUDY OF THE INITIATION OF DETONATIONS. See Abstr. 7564.

532.5

7825. ON THE THEORY OF FLOW OF UNDERGROUND FLUIDS IN COMPRESSIBLE STRATA. A.E.Scheidegger.
Canad. J. Phys., Vol. 37, No. 3, 276-84 (March, 1959).

The problem of flow of a fluid within a compressible porous medium is investigated. It is shown that in general, the motion of t fluid cannot be separated from that of the medium. This leads to a very complex problem of consolidation. However, considerable simplification can be made in applications to the flow of undergroun fluids. In that case, the general geometry of the consolidation can b predicted since the latter can take place in the vertical direction only. Furthermore, in many cases it is possible to neglect the volu compressibility of the porous matrix. Two cases have been considered: that of local isotropy of stress and permeability and that of loc anisotropy of these two quantities. The basic differential flow equation for the two cases is deduced.

532.5

7826. DIFFUSION AND VISCOSITY IN A SPHERICAL CAVITY. S.Broersma.
J. chem. Phys., Vol. 30, No. 3, 707-16 (March, 1959).

A system consisting of two, in principle concentric, spherical surfaces separated by a fluid, is considered. The torque and force required to rotate and translate the inner sphere is calculated, as well as the work necessary to maintain fluid flow around it, the flo pattern at the outer sphere being specified. Using this, general expressions for the diffusion constants for rotation and translation fo the inner sphere and for the effective viscosity of the bulk liquid ar obtained. The inner sphere (a) can be viscous, its surface may slip or adsorb fluid. The effect of a perturbation in the flow pattern at the outer surface (R) is examined. For a small value of a/R, the expressions become those given by Stokes and Einstein for dilute solutions. For the ratio $a/R \cong 1$, the expressions apply to liquids flowing through membranes or porous media. Rotational diffusion aramagnetic hydrates in diamagnetic environment, translational iffusion of ions through membranes, the viscosity of concentrated uspensions and fluid flow through porous media are discussed.

532.511

'827. "FULL" SOLUTION OF THE BOUNDARY VALUE ROBLEM FOR THE EQUATIONS OF NAVIER—STOKES NVOLVING TWO SPATIAL VARIABLES. O.A.Ladÿzhenskaya.
okl. Akad. Nauk SSSR, Vol. 123, No. 3, 427-9 (Nov. 21, 1958). In Russian.

The unique existence is proved of a "full" solution of the -dimensional hydrodynamical equations for a viscous incompressible iquid satisfying an arbitrary initial condition and the boundary ondition of vanishing velocity. By "full" it is meant that the solution s valid for all times at all values of Reynolds' number and for rbitrary forces. R.Eisenschitz

532.511

828. STATIONARY FLOW OF VISCOUS LIQUIDS.
.I.Vorovich and V.I.Yudovich.
okl. Akad. Nauk SSSR, Vol. 124, No. 3, 542-5 (Jan. 21, 1959).
n Russian.

Admitting a wide variety of boundary conditions, the existence, niqueness and existence of derivatives of the solutions of the ydrodynamical equations is proved. R.Eisenschitz

532.517

829. EFFECT OF THE RESERVOIR ON THE FLOW OF A TREAM OF WATER AT SUPERSONIC SPEED.
.F.Vereshchagin, A.A.Semerchan, F.M.Filler and V.A.Galaktionov.
h. tekh. Fiz., Vol. 27, No. 11, 2640-6 (Nov., 1957). In Russian.
nglish translation in: Soviet Physics — Technical Physics ew York), Vol. 2, No. 11, 2451-6 (1957).

A theoretical study of the effect of reservoir volume, compres- r output, and actual pressure, on the pressure fluctuations in a ream of water. For a given reservoir at constant output the higher e pressure the higher its pulsation level and the larger the reser- ir the better the smoothing. The theory is checked by experiment d it is found that a reservoir of 5-6 litres capacity gives adequate noothing. T.C.Toye

532.517.2 : 536.2

HEAT TRANSFER IN LAMINAR FLOW THROUGH A TUBE.
e Abstr. 6822

532.517.4

30. ON THE DENSITY VECTOR OF A TURBULENT ENERGY OW. V.G.Nevzglyadov.
kl. Akad. Nauk SSSR, Vol. 124, No. 2, 288-90 (Jan. 11, 1959).
Russian.

This vector can be simply expressed by means of a second order, mmetrical and covariant tensor:

$$I_k = -L_{ki}\frac{\partial \Pi}{\partial X_i}$$

ere I_k (k = 1,2,3) are the components of the vector in question, is the turbulent pressure, and L_{ki} is the tensor. The author marks that analogous expressions derived by Dryden (J. Meteorol., 1. 13, No. 5, 433, 1956) and Townsend (Abstr. 136, 5147 of 1951) not satisfy covariant conditions. The tensor L_{ki} is determined a current in a circular tube and suggestions are made for actical measurements of the required parameters.
J.K.Skwirzynski

532.517.4

31. SIMILARITY SPECTRA IN ISOTROPIC TURBULENCE.
H.Reid and D.L.Harris.
ys. of Fluids, Vol. 2, No. 2, 139-46 (March-April, 1959).

Similarity solutions are given for the energy spectrum and nsfer function in the initial period of decay for a range of values the Reynolds number using the transfer theory suggested by vásznay. Because of the simple form of the theory, the solution be obtained in closed form for all values of the Reynolds number, this exact solution is useful for analytical purposes. To obtain ailed results, however, it is more convenient to employ numeri- methods. It is found, for example, that the skewness factor S $-\partial u_1/\partial x_1$ varies only between 3.93 K_K for $R_\lambda = 0$ and 2.86 K_K for = ∞, where K_K is the arbitrary constant that occurs in the theory. omparison between the present results and those obtained by using senberg's transfer formula is also made. Some results for the nsfer function in the final period of decay are also given.

532.52

7832. FLOW OF LIQUID HYDROCARBONS IN POROUS VYCOR.
P.Debye and R.L.Cleland.
J. appl. Phys., Vol. 30, No. 6, 843-9 (June, 1959).

Experimental investigation of the flow rates of normal paraffins in porous Vycor glass shows that there are deviations from the viscosity dependence required by Poiseuille's law. A discussion of the application of capillary models to describe flow in porous media in terms of the measured porosity and surface-to-volume ratio points out that such models are not generally applicable, though they give useful results for some purposes. An estimate of the permeability predicted by Poiseuille's law is made by an empirical method which uses gas flow measurements in the Knudsen flow region. The equations of slip flow as derived for gases do not explain the experimental deviations from Poiseuille flow. The concept of a slipping adsorbed layer of molecular thickness at the wall of a capillary is combined with the usual Poiseuille treatment for the interior to give a result which is compatible with experiment.

532.526

7833. IS IT NECESSARY TO CHANGE THE FUNDAMENTAL LAWS OF THE BOUNDARY LAYER, AND THOSE DEPENDENT UPON THEM? P.Vernotte.
C.R.Acad. Sci. (Paris), Vol. 247, No. 17, 1294-6 (Oct. 27, 1958).
In French.

The partial derivative equations of mathematical physics are often difficult to solve for given boundary conditions, and it is suggested that one might use a solution for the velocity in the form $V = f(\xi x^{-m})$ where x is a time variable and ξ a special geometric variable. The particular case of the flow over a semi-infinite plate in the horizontal plane is considered, with a velocity variation perpendicular to it, and the equations governing the boundary layer are discussed. The assumption of a uniform velocity field at infinity is examined with reference to the convection problem where thermal phenomena occur before contact of the fluid with the body concerned. P.G.Morgan

532.59

7834. ON FREE SURFACE OSCILLATIONS IN A ROTATING LIQUID. J.W.Miles.
Phys. of Fluids, Vol. 2, No. 3, 297-305 (May-June, 1959).

The disturbed motion of a liquid having a free surface in a vertical, rotating, circular cylinder and an equilibrium distribution of velocity corresponding to rigid body rotation is studied in linear approximation. It is shown that a vertical gradient of velocity necessarily generates vorticity, whence the disturbed motion cannot remain irrotational. (Earlier studies of this problem were based on shallow water theory, in which approximation the disturbed motion can remain irrotational.) The natural frequencies for the free surface oscillations are studied in some detail for a deep tank (say depth > diameter), and it is found that one effect of rotation is to split the pairs of frequencies (that would have been of equal magnitude and opposite sign) for the nonrotating liquid. In addition, new resonant frequencies are found that have no counterpart for a nonrotating liquid and for which the motion does not fall off exponentially with depth. The results are applied to forced, transverse oscillations of the tank, and explicit solutions are given for three special cases.

532.59 : 536.252

THERMAL INSTABILITY OF VISCOUS FLUIDS.
See Abstr. 6830

532.612.4 : 537.36

7835. THE ROLE OF THE ELECTROKINETIC POTENTIAL IN SOME SURFACE TENSION PHENOMENA. L.B.Robinson.
J. Electrochem. Soc., Vol. 106, No. 6, 520-4 (June, 1959).

The Wagner—Onsager—Samaras theory (without adjustable constants) allows one to calculate the surface tension of an aqueous electrolyte solution as a function of concentration. It predicts that an electrolyte added to water would increase the surface tension. Precise measurements of the surface tension by the capillary rise method give an initial decrease and a minimum in the surface tension—concentration wave. Theory and experiment can be reconciled by taking the electrokinetic effects into account.

MOLECULAR THEORY OF LIQUIDS

532.7

7836. THERMODYNAMICS OF VISCOELASTICITY IN LIQUIDS.
R.E.Nettleton.
Phys. of Fluids, Vol. 2, No. 3, 256-63 (May-June, 1959).

A tensorial ordering parameter, obeying a linear relaxation equation, is introduced to describe the elastic shearing strain exhibited by a liquid at high frequencies. The coefficients in the relaxation-rate equation and the shear modulus in the stress tensor are linked by the Onsager—Casimir reciprocal relations with the result that the total rate of deformation is divided into elastic and viscous parts, in agreement with a hypothesis made by Frenkel to derive the viscoelastic stress relaxation equation of Maxwell. The hypersonic wave velocity is computed from the thermal conductivity by an adaptation of a theory of Debye and from it the shear modulus and shear relaxation time are computed, effects of thermal relaxation being taken into account. In three nonassociated liquids, order-of-magnitude agreement is found with values calculated from a theory of Mooney.

532.7

7837. ANALYTICAL SOLUTION OF POISSON—BOLTZMANN EQUATION FOR TWO-DIMENSIONAL MANY-CENTER PROBLEM.
N.Imai and T.Onishi.
J. chem. Phys., Vol. 30, No. 4, 1115-16 (April, 1959).

The authors have applied the general solution of the two-dimensional Poisson—Boltzmann equation to the problem of the counter-ion distribution around more than two axially symmetrical rod-like poly-ions arranged in their free volume in a solvent.

R.F.Barrow

532.7

7838. DIFFUSION IN PARAFFIN HYDROCARBONS.
D.C.Douglass and D.W.McCall.
J. phys. Chem., Vol. 62, No. 9, 1102-7 (Sept., 1958).

The Carr—Purcell spin-echo method has been used to measure the self-diffusion coefficients of the normal paraffins C_5H_{12}, C_6H_{14}, C_7H_{16}, C_8H_{18}, C_9H_{20}, $C_{10}H_{22}$, $C_{18}H_{38}$ and $C_{32}H_{66}$. The measurements were made over a temperature range in order to obtain activation energies. Within experimental error the plots of log D versus 1/T are linear. As expected the diffusion coefficients decrease with increasing molecular weight. The activation energies increase with increasing molecular weight. It is proposed that the elementary diffusion process involves the translation of an extended molecule parallel to its chain axis. A reduced temperature plot of the diffusion coefficient clusters the data in an interesting manner and the diffusion coefficients for all the hydrocarbons extrapolated to their respective critical points are approximately equal.

532.7 : 538.27

NUCLEAR MAGNETISM IN PURE LIQUIDS. See Abstr. 7192

532.7 : 541.135

TRANSPORT PROCESSES IN LIQUID ALLOYS. See Abstr. 7579

532.72

7839. TRANSPORT PROCESSES IN BINARY LIQUID SYSTEMS. I. DIFFUSION IN THE SUCROSE–WATER SYSTEM AT 25°.
R.R.Irani and A.W.Adamson.
J. phys. Chem., Vol. 62, No. 12, 1517-21 (Dec., 1958).

The diaphragm cell technique has been used to measure the binary and the two self-diffusion coefficients for sucrose—water at 25°. The entire concentration range for sucrose—water at 25° was investigated. Some marker motion experiments are also reported.

532.72

7840. DETERMINATION OF DIFFERENTIAL DIFFUSION COEFFICIENTS. F.T.Wall and R.C.Wendt.
J. phys. Chem., Vol. 62, No. 12, 1581-6 (Dec., 1958).

A method has been developed for determining diffusion coefficients as functions of concentration from data obtained by means of the buoyant frit method. Numerical solutions to the partial differential equation for diffusion, subject to the appropriate boundary conditions, were obtained by means of an electronic digital computer and used for this analysis. From these results it became apparent that the frit method gives directly a good approximation to the differential diffusion coefficient corresponding to the outside bath concentration. Several experiments analysed in light of the computer results suffice to determine the diffusion coefficient as a function of concen tration. Results with KCl and $ZnSO_4$ confirm the validity of this method. In particular, it is shown that D_0, the diffusion coefficient at infinite dilution, can be determined with fair accuracy.

532.7

7841. THE SINGULARITIES OF THE INTEGRALS IN MAYER'S IONIC SOLUTION THEORY. H.L.Friedman.
Molecular Phys., Vol. 2, No. 2, 190-205 (April, 1959).

The terms of the expression previously obtained by Friedman for the cluster integral sum in Mayer's theory are examined as to order in total ion concentration, c, at the limit, c = 0. The order of the singularity at c = 0 is calculated for several of those terms o the irreducible cluster integrals that correspond to graphs of low connectivity but with an arbitrary number of vertices. On the basis of these calculations and two postulates concerning the relation of the singularities of these integrals to others, it is concluded that th terms of the cluster integral sum, when arranged in order of increasing index, are also in increasing order of concentration, and that the first term, $\kappa^3/12\pi$, has a lower order than any other. The order in concentration of the higher terms depends on whether the third moment of the concentration of charge types, $\Sigma c_s z_s^3$, vanishe as it does in solutions of electrolytes of symmetrical charge type.

532.77 : 537.226

7842. ON THE VISCOELASTICITY AND COMPLEX DIELECTRI CONSTANT IN THE PRESENCE OF AN ELECTRIC FIELD AND A SHEARING LAMINAR FLOW IN SOLUTION OF MACROMOLECUL
N.Saitô and T.Kato.
J. Phys. Soc. Japan, Vol. 12, No. 12, 1393-402 (Dec., 1957).

The effect of an electric field on the intrinsic viscoelasticity and the effect of shearing laminar flow on the dielectric properties of dilute solutions are calculated, based on the model of a spheroid macromolecule with dipole moment along its symmetry axis. It is shown that the intrinsic viscosity increases proportionally to the square of the applied electric field and the dielectric constant increases proportionally to the square of the velocity gradient. Simp thermodynamical considerations are given.

532.77 : 539.

7843. THEORY OF DILUTE POLYMER SOLUTIONS. I. CHAIN CONFIGURATION AND LIGHT SCATTERING.
H.Yamakawa and M.Kurata.
J. Phys. Soc. Japan, Vol. 13, No. 1, 78-86 (Jan., 1958).

Statistical properties of a single polymer-chain in a continuou medium are studied on the basis of the pearl-necklace model. Proper account is taken of the spatial interference between segme and of the effect of a heat of interaction between solvent and polym The 2m-th moment of the distribution function of the distance between k-th and l-th segments $\langle R_{kl}^{2m} \rangle$, the mean square distanc between k-th segment and the molecular centre of mass $\langle S_k^2 \rangle$, ar the mean square radius of gyration $\langle S^2 \rangle$ are calculated by using Ursell—Mayer—Teramoto's method of expanding the chain phase integral. The results obtained are of non-Markoffian character at any temperature but the Flory point, and are qualitatively in consi tency with the experimental data of lattice chain obtained by direct counting of its configurations. The angular distribution of scatter light is also calculated and a method is proposed to evaluate $\langle S^2 \rangle$ by the assymmetry method

532.

7844. THEORY OF DILUTE POLYMER SOLUTIONS. II. OSMOTIC PRESSURE. H.Yamakawa.
J. Phys. Soc. Japan, Vol. 13, No. 1, 87-94 (Jan., 1958).

A statistical - mechanical theory of dilute polymer solutions i developed following the solution theory of McMillan and Mayer, an the osmotic second virial coefficient A_2 is calculated taking accou of the intra- and intermolecular interactions. The final expressio for A_2 is expressed in terms of the molecular constants such as the molecular weight, segment size and bond length. The molecul weight dependence of A_2 is improved at least in the vicinity of the Flory point in comparison with the theories of Flory—Krigbaum and Isihara—Koyama.

532

7845. THEORY OF DILUTE POLYMER SOLUTIONS. III. INTRINSIC VISCOSITY. H.Yamakawa and M.Kurata.
J. Phys. Soc. Japan, Vol. 13, No. 1, 94-100 (Jan., 1958).

A theory of the intrinsic viscosity [η] of chain polymer soluti is developed on the basis of the Kirkwood and Riseman scheme, taking some modifications concerning the excluded volume effect nto account. If the volume effect is represented by the linear xpansion factor α of the root mean square radius of gyration, it concluded that $[\eta]$ is proportional to α^2 for the free-draining nolecule and $\alpha^{2.43}$ for the non-free-draining molecule. This implies at the effective hydrodynamic radius of the polymer coil is not roportional to the statistical one in the limit, where the rigid phere model is asymptotically valid; in other words, the more the olymer chain is expanded, the deeper the solvent molecules pene-ate into the polymer coil.

532.78

846. PRECIPITATION FROM SUPERSATURATED SOLUTIONS F INSOLUBLE AND SPARINGLY SOLUBLE METAL SALTS. THE PARTICLE SIZE OF CRYSTALLINE PRECIPITATES.
.Packter.
phys. Chem., Vol. 62, No. 9, 1025-9 (Sept., 1958).

The factors that determine the crystal size of precipitates from persaturated insoluble metal salt solutions at different super-turation are discussed. The experimental data are best explained a two-stage consecutive nucleation and condensation mechanism r precipitation, rather than by a sol coagulation mechanism. Duke d Brown's analysis for such a former process has been extended take into account those factors other than interfacial energy, that ay determine the rate of the nucleation process. At any super-aturation, the crystal size of precipitates of salts of widely different olubilities is mainly determined by the solute concentration, rather an by the rate constants for nucleation or crystal growth.

MECHANICS OF GASES
VACUUM TECHNIQUE

533.1.07

847. VACUUM-TYPE GAS-FLOW CALIBRATOR.
.A.Strauss and R.Edse.
ev. sci. Instrum., Vol. 30, No. 4, 258-9 (April, 1959).

A vacuum-type gas-flow calibrator was designed and constructed or making accurate calibrations of flowmeters needed for the investi-ation of high-pressure flames. This calibrator operates by auto-atically measuring the time required to pressurize a known volume rom a near vacuum to 1 atm. The gas volume flow rate is obtained y dividing the calibration volume by the pressurization time and pplying corrections from PVT data. This apparatus has been uccessfully used to calibrate flowmeters for use with hydrogen, xygen, nitrogen, air, methane, nitric oxide, carbon monoxide, and arious homogeneous nonexplosive gas mixtures.

533.15

848. WATER VAPOR PERMEABILITY OF POROUS MEDIA.
V.Woodside.
anad. J. Phys., Vol. 37, No. 4, 413-16 (April, 1959).

Following the analogy between the laws of heat conduction and apour diffusion, two theoretical expressions for the thermal con-uctivity of a composite medium are applied to the water vapour ermeability coefficient of certain porous media. It is shown that oth expressions reduce to a form very similar to the empirical elationships found by Penman and Edenholm for soils, glass spheres, harcoal, and cellular concrete. The calculation of the variation of ater vapour permeability with density for a cellular lightweight oncrete is illustrated.

533.17 : 539.217.5

849. MEASUREMENT OF THE EMISSION OF NITROGEN ISSOLVED IN PURE IRON INTO A VACUUM.
.Jaeckel and H.Junge.
nn. Phys. (Leipzig), Vol. 20, No. 1-6, 331-6 (1957). In German.

A method utilizing the dependence of the damping of elastic scillations of iron wires on the amount of nitrogen absorbed in them, described; the results show that at 520°C about 10^{13} nitrogen toms/cm^2/sec are given out into a vacuum of 2×10^{-5} mm Hg from ires given a specified treatment. J.Dutton

533.275 : 551.508.71

850. RECORDING MICROWAVE HYGROMETER. J.Sargent.
ev. sci. Instrum., Vol. 30, No. 5, 348-55 (May, 1959).

A description is given of a microwave refractometer designed o measure and record the water vapour pressure in a moving air tream, particularly at very low vapour pressures. The instrument as a sensitivity of 0.004 mm Hg with a four decade range extending to 71.3 mm Hg vapour pressure. By means of microwave techniques the difference in refractive index between dry and humid air is determined and then converted to vapour pressure by an empirical formula. The instrument can be readily calibrated by the use of pure gases whose dielectric constants are precisely known. Because of the automatic null-balancing technique used, the instrument has excellent calibration stability. Test results involving the measurement of known vapour pressures in the ranges of 0 to 0.15 mm Hg and 0 to 15 mm Hg are described. Possible applications of this instrument for the measurement of refractive index variation and its use for quality control are briefly discussed.

533.5 : 531.788

7851. THE PUMPING PROPERTIES OF THE COLD CATHODE IONIZATION GAUGE. L.Pátý.
Czech. J. Phys., Vol. 7, No. 1, 113-15 (1957).

Experimental curves of the pumping speed S of a Penning gauge versus gas pressure p are given for various gases. The curves show that (except for 0_2), S has a single maximum value (~ 3 l/sec for air and N_2 and ~ 0.5 l/sec for inert gases) at a value of p (different for each gas) lying within the range 4×10^{-4} to 5×10^{-3} mm Hg. Curves of S versus p for a two-stage rotary pump, a Penning gauge and a Bayard—Alpet ionization gauge show that these three devices could be used in conjunction to obtain a residual gas pressure of 10^{-11} mm Hg. J.Dutton

533.5 : 531.788.6

7852. EXTENDED RANGE PIRANI GAUGE. A.W.Smith.
Rev. sci. Instrum., Vol. 30, No. 6, 485-6 (June, 1959).

A Pirani gauge has been developed which is useful from atmospheric pressure to 10^{-5} mm Hg. This gauge has two elements: a platinum ribbon active in the low-pressure region and a thermistor bead active in the high-pressure region. By a simple but unique electrical circuit, the sensitivity in the intermediate region is maintained at a high level. In any pressure region, the gauge has the optimum characteristics possible with a Pirani-type gauge.

533.5 : 531.788.6

7853. PROGRESS IN THE THEORY, CONSTRUCTION AND APPLICATION OF THERMAL AND IONIZATION VACUUM GAUGES.
A.Bláha.
Slaboproudy Obzor, Vol. 20, No. 4, 222-30 (1959). In Czech.

The theory of thermal (resistance and thermo-electric) vacuum gauges is dealt with in detail. It is shown that the gauges can cover a pressure range from 10^{-4} to 10^2 mm Hg, but the resistance gauges are more sensitive than the thermo-electric devices. The author proposed and constructed a successful gauge which combined four thermocouples and a resistance wire. The device operated at a constant temperature (or resistance). The theory of ionization gauges (thermo-emissive, radio-ionization and magnetic) is also considered. The thermo-emissive gauges can be employed at pressures from 10^{-10} to 10 mm Hg, while the radio-ionization devices (alphatrons) can cover the range from 10^{-3} to 10^3 mm Hg. The magnetic (Penning) gauges can measure pressures from 10^{-9} to 1 mm Hg. The thermal gauges have nonlinear (parabolic or hyperbolic) characteristics, while the ionization gauges have linear characteristics over a large portion of the operating range. R.S.Sidorowicz

533.5 : 531.788.7

7854. TETRODE IONIZATION MANOMETER.
E.A.Penchko and L.P.Khavkin.
Pribory i Tekh. eksper., 1959, No. 1, 128-9 (Jan.-Feb.). In Russian.

Description of a four-electrode ionization manometer, stabilized by negative feedback between the anode current and the control-grid voltage. Pressure range from 10^{-9} to 10^{-3} mm Hg. P.Collins

533.5 : 531.788.7

7855. OSCILLATIONS IN THE OMEGATRON. L.R.McNarry.
Canad. J. Phys., Vol. 36, No. 12, 1710-13 (Dec., 1958).

An experimental study was made of the oscillations in the electron collector current of an omegatron, which appear to cause an increase of background ion current. Results of the time dependence of the various effects are given, which on the whole are not in accord with the suggested oscillation mechanism. D.Walsh

533.5 : 531.789

7856. DETECTION OF SMALL LEAKS FILLED BY A LIQUID.
R.Jean.
Vide, Vol. 13, 188-92 (July-Aug., 1958). In French.

The author shows that a liquid in a small leak, whose transverse dimensions are less than 10^{-4} cm, is strongly held by surface tension forces. These leaks must therefore be freed of liquid before any thorough leak test can be made on a system. The author discusses ways of removing this liquid and concludes that heating under vacuum is the only convenient method. R.D.Hudson

533.5 : 531.789

7857. THE MEASUREMENT OF THE SPEED OF VACUUM PUMPS. D.A.Degras.

Vide, Vol. 13, 268-76 (Nov.-Dec., 1958). In French.

Gives a comprehensive survey of the various methods used, which determine the pressure obtained by the pump in a system which has a controlled leak. Also analyses the conditions which must be realized in order to give accurate and reproducible results. The need is stressed for a standard method to be used in all countries. R.D.Hudson

533.5 : 531.789

7858. INSTRUMENTS FOR MEASURING THE SPEED OF VACUUM PUMPS. J.Amoignon.

Vide, Vol. 13, 277-80 (Nov.-Dec., 1958). In French.

Surveys the instruments used for measuring the speed of vacuum pumps by the "constant-pressure" method. Compares the results obtained from such a method with those obtained from the "calibrated-leak" method and concludes that the latter method gives the complete characteristics of the pump, over all pressures, with more precision. R.D.Hudson

533.5

7859. APPARATUS FOR FEEDING Ti INTO A VAPOUR-ION PUMP. E.Thomas and R.Van Steenbrugghe.

Vide, Vol. 13, 208-10 (July-Aug., 1958). In French.

The authors describe an apparatus which will cut titanium, under vacuum, and then drop the small pieces into the furnace crucible below. This has the advantage that the wire is not raised to the high potential of the crucible as in those methods which use a continuous feed. The rate of evaporation of the titanium can be modified by altering the cutting rate. R.D.Hudson

533.5

7860. AN INVESTIGATION OF SOME VACUUM PROPERTIES OF EPOXY RESINS. E.A.Kolenko and V.G.Yur'ev.

Zh. tekh. Fiz., Vol. 28, No. 10, 2259 (1958). In Russian.

Gives short account of investigation conducted with epoxy resins with temperature of polymerization of 140°C. Their excellent adhesive properties to glass and some metals suggest their use as seals in vacuum tubes. J.M.Zarzycki

533.56

7861. ANNULAR JET PUMP. W.H.Haak and F.Vrátný.

Rev. sci. Instrum., Vol. 30, No. 4, 296-7 (April, 1959).

A two stage high-speed mercury diffusion pump is described which it is claimed cuts down the diffusion of the mercury vapour into the upper trapping mechanism and hence enables the pump to be run for long periods. R.D.Hudson

533.59

7862. HIGH-TEMPERATURE LABORATORY VACUUM FURNACE. E.V.Kornelsen and J.O.Weeks.

Rev. sci. Instrum., Vol. 30, No. 4, 290-1 (April, 1959).

Describes a small resistance-heated furnace, using a resistance element fabricated from a single thin sheet of molybdenum, which can achieve temperatures of up to 1600°C. R.D.Hudson

533.59

7863. USE OF A SILVER TUBE TO ADMIT OXYGEN TO A VACUUM SYSTEM. N.R.Whetten and J.R.Young.

Rev. sci. Instrum., Vol. 30, No. 6, 472-3 (June, 1959).

Oxygen admitted to a vacuum system through a silver tube was analysed with a mass spectrometer. The oxygen was found to be of high purity. A satisfactory silver tube assembly is described, and some advantages over other methods of admitting oxygen are discussed.

533.6.011.3

7864. ON SOME SINGULAR SOLUTIONS OF THE TRICOMI EQUATION RELATING TO TRANSONIC FLOW. J.B.Diaz.

J. Phys. Soc. Japan, Vol. 12, No. 12, 1425 (Dec., 1957).

533.6.011.4 : 541.124

7865. SUPERSONIC NOZZLE FLOW WITH A REACTING GAS MIXTURE. P.P.Wegener.

Phys. of Fluids, Vol. 2, No. 3, 264-75 (May-June, 1959).

An investigation was made of the stationary supersonic nozzle flow of a reacting gas mixture of nitrogen tetroxide and dioxide carried at low concentration in nitrogen. A judicious choice of supply conditions and nozzle geometry made it possible to produce flows either in chemical equilibrium or in states between this and the frozen flow. The flow could be fully determined from pressure and area measurements and, by applying an equation for the reactio mechanism, rate constants of recombination could be found. The results of these measurements agreed with those obtained from independent optical absorption measurements, and the third-order rate constant for recombination was found to be 3×10^{14} cm^{6} mole^{-2} sec^{-1} for $210 < T < 330$°K. Finally, experiments with stationary oblique shocks led to a determination of the dissociation rate constant.

533.6.011.5

7866. AN APPROXIMATE SOLUTION OF THE HYPERSONIC LAMINAR BOUNDARY-LAYER EQUATIONS AND ITS APPLICATIO T.Nagakura and H.Naruse.

J. Phys. Soc. Japan, Vol. 12, No. 11, 1298-304 (Nov., 1957).

Approximate formulae of the displacement thickness and the skin friction of the laminar boundary layer are derived by use of von Kármán's integral method, assuming a heat-insulated wall, a Prandtl number of unity and Chapman and Rubesin's formula for the variation of viscosity with temperature. The results obtained a compared with some exact solutions. Because of the good agreemen it seems that these formulae are very useful. These formulae, together with the tangent-wedge-approximation, are applied to the vis flow over slender bodies with a sufficiently sharp leading edge. As an example, the pressure distribution over a flat plate is calculated numerically over the entire region of the surface. Comparison with the theoretical results and experimental values of other authors is made.

533.6.011.5 : 534.222.2

7867. ON A THEORY OF SHOCK WAVES IN LOCALLY SUPERSONIC ZONE AND A NEW BOUNDARY-VALUE PROBLEM FOR TRICOMI'S EQUATION. S.Tsugé.

J. Phys. Soc. Japan, Vol. 12, No. 12, 1412-19 (Dec., 1957).

The hodograph behaviour of the shock wave in transonic flow with non-uniform initial state is discussed. Besides the shock polar two conditions are derived which, as a special case, comprise Busemann's spine and serve to eliminate the indeterminableness which constitutes a specific difficulty for the treatment of high subsonic flow with shock waves. Applying these three equations to the transonic flow over an airfoil, a new boundary-value problem is proposed. The problem still involves indeterminableness, but in a special case when the airfoil has a ridge it can be simplified so as to develop further analysis.

533.6.011.5

7868. FLUCTUATION MEASUREMENTS IN A SUPERSONIC TURBULENT BOUNDARY LAYER. A.L.Kistler.

Phys. of Fluids, Vol. 2, No. 3, 290-6 (May-June, 1959).

Hot-wire measurements of the fluctuations in turbulent, constan pressure boundary layers were made at Mach numbers of 1.72, 3.56, and 4.76 and a Reynolds number based on momentum thickness of about 30 000. The distribution of the static-temperature fluctuati levels through the boundary layer is approximately similar at the various Mach numbers, and the levels are proportional to the mean static-temperature difference across the boundary layer. A decrease of the velocity fluctuation levels is observed as the Mach number is increased. There is a high negative correlation between the velocity and temperature fluctuations at all Mach numbers.

533.6.011.5

7869. LAMINAR BOUNDARY LAYER WITH SUCTION AND INJECTION. R.J.Gribben.

Phys. of Fluids, Vol. 2, No. 3, 305-18 (May-June, 1959).

With the assumptions of a heat insulated body, a Prandtl numbe of unity and a linear temperature—viscosity relation the axisymmetric equations governing a given high-speed compressible flow are reduced to the equations describing an incompressible two-dimensional flow past a flat plate with a determinable main stream and normal wall velocity distribution. The results are applied to th supersonic flows over a cone with wall velocities proportional (i) to the first power and (ii) to the inverse-half-power of distance along a generator when the resulting incompressible flows are known. Also the flow near the tip of a general slender body of revolution in supersonic flow with constant wall velocity is obtained by solving numerically the equations of the correlated incompressible flow It s also shown that, if the assumption of an insulated body is discarded, given high-speed compressible flow may still be correlated with a leterminable low-speed compressible flow.

533.6.011.5 : 534.222.2

870. ON THE EXISTENCE OF RECOMBINATION SHOCKS.
.Feldman.
hys. of Fluids, Vol. 1, No. 6, 546 (Nov.-Dec., 1958).

In the Prandtl—Meyer expansion of a high temperature lissociated gas, the flow time through the fan may be made small ompared with the reaction time by considering streamlines close o the wall. The flow is chemically frozen as it emerges from the an but relaxes to equilibrium as it flows along the wall, the Mach ngle increasing as the equilibrium value is approached. For finite ates of recombination, the Mach lines emanating from the wall teepen and coalesce into a shock. The qualitative discussion has een checked by a complete characteristic solution for a given exansion, but the strength of the shock has not been determined.
P.G.Morgan

VIBRATIONS . ACOUSTICS

534.152

871. OBSERVATIONS ON RESOLUTION AND ON FIELD 'ARIATIONS IN NEAR FIELD SONIC OPTICAL SYSTEMS.
.E.Suckling.
. Acoust. Soc. Amer., Vol. 31, No. 6, 678-80 (June, 1959).

The author is working towards the development of an ultrasonic iewing system which is an analogue in ultrasound of conventional light hotography. In the present paper it is shown that a sonic lens is ble to resolve two sources of ultrasound whose spacing is about qual to the length of one wave of the sonic energy in use. It is also hown that at the frequency being used (3 Mc/s) uniform illumination f an object for sonic viewing is very difficult because Fresnel near eld and other diffraction and interference effects occur very eadily and that these effects are frequently themselves not stable.

534.2

872. SURFACE WAVES IN ACOUSTICS. A REVIEW.
.M.Brekhovskikh.
kust. Zh., Vol. 5, No. 1, 4-13 (1959). In Russian.

The paper summarizes a review read at the Fourth All-Union onference on Acoustics, held in June 1958. The author discusses lane acoustic surface waves propagated in solids along plane and orrugated surfaces. It is shown that in the latter case standing 'aves may be established between the corrugations. The author eals also with symmetrical surface waves, such as those ropagated along a smooth circular cylinder with a surrounding aseous sheath or along a corrugated cylinder. Excitation and mission of surface waves are discussed. A.Tybulewicz

534.2

873. PROPAGATION OF SPHERICAL ACOUSTIC WAVES OF INITE AMPLITUDE IN A VISCOUS HEAT-CONDUCTING IEDIUM. K.A.Naugol'nȳkh.
kust. Zh., Vol. 5, No. 1, 80-4 (1959). In Russian.

The form of a finite-amplitude wave alters as it is propagated. his is because non-linear effects increase the steepness of the ave profile. If the medium is viscous and heat-conducting the tter two properties tend to smooth out the profile and to decrease e velocity and temperature gradients. The effect of viscosity and eat conduction is, therefore, the opposite of the non-linearity of e medium. The form of a finite amplitude wave in a viscous and eat-conducting medium will be determined by the ratio of non-near and dissipative (viscosity and heat conduction) effects. The thor discusses propagation of spherical waves of finite amplitude roduced by a harmonically pulsating sphere, whose radius is rge compared with the emitted wavelength. The problem is dealt ith using the Krȳlov—Bogolyubov method. Conditions when non-near effects become important are found. A.Tybulewicz

534.2

374. THICKNESS—SHEAR VIBRATIONS OF CIRCULAR BARS.
H.Baltrukonis and W.G.Gottenberg.
Acoust. Soc. Amer., Vol. 31, No. 6, 734-9 (June, 1959).

Exact general solutions of the three-dimension elasticity equaons of motion in polar cylindrical coordinates are obtained for axisymmetric and antisymmetric thickness—shear vibrations. These solutions are applied in solving five solid and hollow circular bar problems. Natural frequencies are tabulated.

534.2

7875. ELASTIC WAVE PROPAGATION IN HOMOGENEOUS AND INHOMOGENEOUS MEDIA. F.C.Karal,Jr and J.B.Keller.
J. Acoust. Soc. Amer., Vol. 31, No. 6, 694-705 (June, 1959).

A general method is developed for the solution of the linearized equations of elasticity for both homogeneous and inhomogeneous media. This method yields solutions which describe propagating waves which may be pulses, rapidly changing wave forms, or periodic waves. It is not restricted by the usual considerations which depend upon separation of variables. The solution consists of a series of terms, the first of which describes the wave motion predicted by geometrical optics. Subsequent terms account for certain types of diffraction effect. The series is not necessarily convergent but is presumably asymptotic to the solution.

534.2

7876. PROBLEM OF ELASTIC BAR WITH MIXED TIME-DEPENDENT END CONDITIONS OF GENERAL FORM.
G.P.DeVault and C.W.Curtis.
J. Acoust. Soc. Amer., Vol. 31, No. 5, 635 (May, 1959).

A procedure is outlined for formulating an exact solution to any problem involving an elastic cylindrical bar with a free lateral surface and with mixed time-dependent end conditions. The method suggested is an extension to three dimensions of a transform method proposed previously for solving two-dimensional problems involving only longitudinal strain.

534.2

7877. THE PROPAGATION OF PLANE IRROTATIONAL WAVES THROUGH AN ELASTOPLASTIC MEDIUM. L.W.Morland.
Phil. Trans. A, Vol. 251, No. 997, 341-83 (1959).

This paper is an attempt at a systematic investigation of wave propagation in a metal, treating interactions between elastic and plastic waves, and the formation and propagation of shock waves, in the general case of motions with unidirectional strain arising from an initial smooth loading—unloading pulse. A stress—strain relation with linear elastic paths and concave-upward plastic paths (where compression is measured as positive) is derived and used so that the elastic wave velocity is uniform, and the plastic wave velocity an increasing function of stress. The analysis is in terms of engineering stress and strain with a Lagrangian coordinate system. Analytic solutions to the interactions between different types of continuous waves are developed incorporating an expression for the motion of the elastic-plastic boundary. An analysis of the breakdown of a smooth plastic compression wave into a shock wave is presented, and the propagation conditions derived. It is shown that the heat dissipated is proportional to the cube of the strain jump, its low value for moderate shock strength suggests that the shock does not appreciably affect the stress—strain relation, an assumption from which a solution for the unloading of a plastic compression front by an overtaking elastic wave, while shock formation is taking place, is derived. A numerical illustration of this solution for a particular pulse in aluminium is given.

534.2 : 550.341

FACTORS AFFECTING ELASTIC WAVE VELOCITIES IN POROUS MEDIA. See Abstr. 7660

534.21

7878. NONAXIALLY SYMMETRIC MOTIONS OF CYLINDRICAL SHELLS. I.Mirsky and G.Herrmann.
J. Acoust. Soc. Amer., Vol. 31, No. 2, 250 (Feb., 1959).

This note corrects errors made in an earlier paper (Abstr. 2189 of 1958) and gives a revised set of phase velocity curves for n = 1 to replace those of the original Fig. 3. H.J.H.Starks

534.21

7879. EXPERIMENTAL STUDY OF THE PROPAGATION OF SOUND OVER GROUND. F.M.Wiener and D.N.Keast.
J. Acoust. Soc. Amer., Vol. 31, No. 6, 724-33 (June, 1959).

The attenuation of sound propagated out-of-doors is conveniently separated into attenuation due to spherical divergence and excess attenuation due to atmospheric and terrain effects. This excess attenuation is principally caused by sound absorption in the air, the refractive effects of temperature and wind gradients, by turbulence and the effects of terrain and ground cover. To investigate these effects the propagation of sound over open, level ground, through dense evergreen forests, and between hilltops was studied experimentally in the frequency range between about 300 and 5000 c/s.

Extensive micrometeorological instrumentation was utilized to measure and record the relevant micrometeorological parameters simultaneously with the acoustic data for a wide variety of weather conditions. Data on the attenuation of the mean received sound pressure level as well as on the fluctuations about the mean were obtained and correlated with the state of the atmosphere. Over open, level terrain, the excess attenuation upwind was found to exceed that for downwind propagation by as much as 25-30 dB for source and receiver heights of 12 and 5 ft, respectively. Temperature and wind gradients near the ground-air interface largely account for this difference. In hilltop-to-hilltop propagation, wind direction is of secondary importance and in dense woods absorption and scattering control. Empirical functions were derived for the purpose of estimating the mean excess attenuation as a function of frequency and distance, for a given set of micrometeorological conditions. These charts were found useful in many practical problems involving the propagation of sound over open level ground.

534.213.4

7880. PROPAGATION OF TRAVELING WAVES IN A CIRCULAR CYLINDER HAVING HEXAGONAL ELASTIC SYMMETRY.
N.G.Einspruch and R.Truell.
J. Acoust. Soc. Amer., Vol. 31, No. 6, 691-3 (June, 1959).

The problem of propagation of travelling waves in a right circular cylinder having hexagonal elastic symmetry is considered here. Exact expressions for the displacements produced by both the compressional and torsional modes are obtained. A conclusion of importance in ultrasonic methods is the result that the compressional and torsional modes propagate independently without coupling either through the equations of motion or the boundary conditions. A condition relating the frequency and wave number of the torsional wave is derived.

534.22 : 532.7

7881. ULTRASONIC VELOCITY IN COBALT AND CADMIUM SULPHATE SOLUTIONS AT DIFFERENT TEMPERATURES AND CONCENTRATIONS. S.Panda and B.S.Mohanty.
Indian J. Phys., Vol. 31, No. 11, 560-3 (Nov., 1957).

Ultrasonic velocities were measured over a concentration range 0.05 to 0.5 molar and over a temperature range 30° to 50°C. Values of adiabatic compressibilities were computed.

534.22 : 539.32

7882. TEMPERATURE DEPENDENCE OF FRACTIONAL VELOCITY CHANGES IN A SILICON SINGLE CRYSTAL.
F.Stein, N.G.Einspruch and R.Truell.
J. appl. Phys., Vol. 30, No. 6, 820-5 (June, 1959).

An ultrasonic interferometer technique for measuring the temperature dependence of the relative change in elastic constants is described in detail. Results are reported for measurements carried out as a function of frequency from 10 to 170 Mc/s, for compressional wave propagation along the [100] axis of silicon over a temperature range of −60° to +15°C. The mean value of $(1/c_{11}) \times (dc_{11}/dT)$ obtained is $55.59 \pm 0.81 \times 10^{-6}\ (^{\circ}C)^{-1}$, and no frequency dependence of $(1/c_{11})\ (dc_{11}/dT)$ was found.

534.22

7883. ON THE SPEED OF SOUND IN AIR.
R.A.Gross and C.L.Eisen.
Phys. of Fluids, Vol. 2, No. 3, 276-9 (May-June, 1959).

In a high-temperature gas, the speed of sound depends upon the chemical composition, sound frequency, and chemical reaction rates. Two limiting sound speeds are normally distinguished: that of "frozen" or constant chemical composition, and the "equilibrium" sound speed. Equations to determine these two sound speeds are presented for a nitrogen—oxygen system and numerical data are presented for conditions behind a normal shock in air to a speed of Mach 20.

534.222 : 551.51

7884. FOCUSING OF SOUND ENERGY IN THE AIR DUE TO WIND EFFECTS. Y.Rocard.
C.R. Acad. Sci. (Paris), Vol. 248, No. 4, 538-40 (Jan. 26, 1959).
In French.

Theoretical addition to a previous note (see Abstr. 3809 of 1958) to include the effect of large atmospheric disturbances.

H.D.Parbrook

534.222.2

7885. SMOKE STREAMS AS TRACERS IN SHOCK TUBE FLOWS.
J.C.Muirhead.
J. appl. Phys., Vol. 30, No. 5, 789 (May, 1959).

Streams of tobacco smoke were used for the measurement of the density and particle velocity of shock waves in air with Mach numbe of 1.158 to 1.363. The experimental results agree very closely with values calculated from the shock front velocity by mass and momentum conservation across the shock.

R.Schnurmann

534.222.

7886. ABLATION STUDIES IN A SHOCK TUBE.
R.W.Nicholls, W.H.Parkinson and H.Van der Lann.
J. appl. Phys., Vol. 30, No. 5, 797-8 (May, 1959).

Statistical photomicroscopic particle size measurements on sieved Fe particles made before and after shock-treatment with helium-driven shock waves in argon up to Mach 6.7 enabled the ablation (or mass loss) from the average particle to be inferred. The measurements support the convective rather than the meteor model of heat transfer.

R.W.Nicholl

534.222.

7887. A STUDY ON THE ATTENUATION OF SHOCK WAVES DUE TO OBSTACLES IN THE PASSAGE.
R.Kawamura and H.Kawada.
J. Phys. Soc. Japan, Vol. 12, No. 11, 1290-8 (Nov., 1957).

Results are reported of a shock-tube experiment on the retardation of shock waves due to obstacles in their path. A one-dimensional analysis is applied to the flow field resulting from the interaction of shocks and obstacles, and a theoretical relation is derived between the attenuation of shocks and the resistance of the path. The drag coefficients of a series of simple bluff obstacles used in the experiment are estimated. Comparisons with available steady-flow data are made and the results discussed.

534.222.

7888. LAMINAR BOUNDARY LAYER DEVELOPMENT BEHIND SHOCK WAVES IN ARGON. R.E.Duff.
Phys. of Fluids, Vol. 1, No. 6, 546-7, (Nov.-Dec., 1958).

The equations describing the development of a laminar boundary layer behind a shock wave are solved by means of a computer for initial conditions corresponding to several strengths of shock. The results compare favourably with previous calculations, with agreement within 2% for the velocity gradient at the wall, assuming a constant Prandtl number and specific heat ratio and a perfectly conducting wall. It is suggested that the temperature gradient is independent of Prandtl number. The shear stress at the wall and heat transfer to the wall may be calculated from the tabulated data; figures comparing the boundary layer profiles of temperature and velocity for different shock compressions show that the boundary layer thickness is practically independent of shock strength.

P.G.Morga

534.222.

7889. TWO-DIMENSIONAL GASEOUS DETONATIONS: VELOCI DEFICIT. J.A.Fay.
Phys. of Fluids, Vol. 2, No. 3, 283-9 (May-June, 1959).

The measured velocity of gaseous detonation waves is less than that predicted by the Chapman—Jouguet plane wave theory. T velocity deficit (difference between theoretical and measured velocities) was found earlier to vary inversely with the tube diameter and initial pressure. A quantitative explanation of this effec is advanced by determining the growth of the viscous boundary layer on the tube wall and its effect upon the flow in the reaction zone of the detonation front. It is proposed that the boundary layer displacement effect within the reaction zone produces a uniform flow divergence throughout the detonation front. The velocity deficit due to this two-dimensional flow is determined, using measure values of reaction zone thickness. The agreement of the velocity deficit with measured values is within a factor of two for the five hydrogen—oxygen—inert-gas mixtures and one acetylene—oxygen mixture for which sufficient data are available.

534.222.2 : 535.3

7890. GENERATION AND DETECTION OF THE H^--CONTINUU IN A SHOCK-WAVE TUBE. O.Weber.
Z. Phys., Vol. 152, No. 3, 281-93 (1958). In German.

An experimental investigation of the continuum in the range 4400 A to 5700 A agrees with theory in respect of absolute intensit and spectral intensity distribution. The introduction of an 80% krypton, 20% hydrogen mixture in the low pressure zone of the tub enabled the temperature to rise sufficiently to allow $H + e = H^- + h$ to occur with sufficient intensity.

C.G.Morg

534.222.2 : 541.126

391. COMBUSTION INVESTIGATION IN THE HYPERSONIC ЮCK TUNNEL DRIVER SECTION. H.T.Nagamatsu and E.D.Martin. appl. Phys., Vol. 30, No. 7, 1018-21 (July, 1959).

An investigation was made of the combustion of stoichiometric ixtures of hydrogen and oxygen with a varying percent of helium in e constant volume driver section for a hypersonic shock tunnel. he pressure was measured as a function of time for a number of itial pressure, mixture ratios, and multiple sparks for ignition. he maximum pressures observed were close to that expected for nooth burning. When detonation was encountered, the ratio of the ak pressure to the initial pressure was about 50.

534.222.2 : 536.71

SHOCK-WAVE COMPRESSION STUDY OF LIQUID TNT.
ee Abstr. 6960

534.222.2 : 533.6.011.5

SHOCK WAVES IN A LOCALLY SUPERSONIC ZONE.
ee Abstr. 7867

534.222.2 : 533.6.011.5

THE EXISTENCE OF RECOMBINATION SHOCKS.
ee Abstr. 7870

534.23

92. DEPENDENCE OF THE AMPLIFICATION FACTOR OF AN COUSTIC FOCUSING SYSTEM ON THE ULTRASONIC INTENSITY WATER. D.V.Khaminov.
ust. Zh., Vol. 3, No. 3, 294-6 (1957). In Russian.

The amplification factor of an acoustic focusing system is fined as the ratio of the intensity at the focus to the mean tensity at the exit of the system. This factor decreases with e ultrasonic intensity in water because absorption increases th intensity and therefore a smaller portion of the ultrasonic ergy available at the system exit reaches the focus.

534.23

93. THERMODYNAMIC THEORY OF ABSORPTION OF NITE-AMPLITUDE SOUND IN RELAXING MEDIA. A.L.Polyakova.
ust. Zh., Vol. 5, No. 1, 85-90 (1959). In Russian.

Propagation of sound of finite amplitude is considered using ermodynamics of irreversible processes. It is assumed that o states are possible in the medium in which sound is propagated: ansition between these two states occurs under the action of und (relaxation). Such transitions are due to transfer of trans- ional energy of molecules to internal processes (for example orational or rotational decrease of freedom, chemical reactions,). An expression is obtained for energy dissipated in such ocesses. It is shown that finite-amplitude sound is absorbed ore strongly than sound of infinitely small amplitude. The sorption maximum is found to be displaced towards frequencies ver than the relaxation frequency. A.Tybulewicz

534.23

94. ULTRASONIC SPECTROSCOPY IN LIQUIDS. T.A.Litovitz.
Acoust. Soc. Amer., Vol. 31, No. 6, 681-91 (June, 1959).

The molecular basis for ultrasonic absorption in liquids is viewed. The various loss mechanisms are all relaxation processes ich include such phenomena as vibrational, isomeric, structural d shear relaxation effects. The relation between such factors the relaxation time and the properties of the liquid are considered.

534.23

95. MEASUREMENTS OF THERMAL RELAXATION IN CO_2 TENDED TO 300°C. F.D.Shields.
Acoust. Soc. Amer., Vol. 31, No. 2, 248-9 (Feb., 1959).

The tube method was used to extend measurements of sound sorption in carbon dioxide to 300°C. Results indicate that all of vibrational specific heat in CO_2 relaxes with a single relaxation ne. This relaxation time at 305°C was found to be 3.05×10^{-6} sec.

534.23 : 537.311.33

ACOUSTOELECTRIC EFFECT IN N-TYPE GERMANIUM.
Abstr. 6969

534.23 : 539.374

ABSORPTION OF ULTRASONIC WAVES IN POLYISOBUTYLENE.
Abstr. 7553

534.232 : 537.228.1

96. DISPLACEMENT OF THE RESONANCE FREQUENCIES OF PLANE PIEZOELECTRIC GENERATOR ON COUPLING TO AN TIVE LOAD. A.A.Anan'eva.
ust. Zh., Vol. 3, No. 3, 282-5 (1957). In Russian.

534.232

7897. NEW THEORY OF JET-NOISE GENERATION, DIRECTIONALITY, AND SPECTRA. H.S.Ribner.
J. Acoust. Soc. Amer., Vol. 31, No. 2, 245-6 (Feb., 1959).

A theory of jet noise is developed from the observation that in low-speed turbulence Lighthill's quadrupoles combine to behave like simple sources $\sim\partial^2 p^{(0)}/\partial t^2$, where $p^{(0)}$ is the "incompressible" local pressure in the turbulence. An integral for the far-field intensity involves the space-time pressure covariance R within the turbulence. Choice of R in a worked example shows how pronounced directionality results from pattern "convection" (modified by fluctuation) in conjunction with the time retardation. Further directionality is accounted for in terms of a Green's function (discussed qualitatively but not worked out) for a point source at rest in the mean shear flow, describing the lateral refraction and diffraction.

534.232 : 612.17

7898. INTRACARDIAC ACOUSTICS.
J.D.Wallace, J.R.Brown,Jr, D.H.Lewis, G.W.Deitz,III and A.Ertugrul.
J. Acoust. Soc. Amer., Vol. 31, No. 6, 712-23 (June, 1959).

The operation of the human heart together with the sounds resulting from normal operation are discussed. Examples of the diagnostic, intracardiac sounds due to several of the common congenital lesions are cited and analysed. Transmission and magnitude of heart sounds within the heart were measured and are reported.

534.232 : 621.395.623.7

7899. EVALUATION OF A MODULATED AIR-FLOW LOUDSPEAKER. J.C.Webster, R.G.Klumpp and A.L.Witchey.
J. Acoust. Soc. Amer., Vol. 31, No. 6, 795-9 (June, 1959).

As part of an over-all evaluation of the USNEL Flight Deck Communications System, an RCA modulator air-flow loudspeaker (air speaker) was tried out as a speech and alarm signalling transducer on the flight deck of an aircraft carrier. Tests with 200 to 6000 c/s noise showed that the air speaker produced 130 dB SPL at optimum points on the deck, as compared with 110 dB for the present system. Speech intelligibility and alarm detection tests showed the air speaker to be usable with jet aircraft at idle (30%) power while the present loudspeakers could not be heard. Neither loudspeaker system was adequate with jets at full power.

534.25 : 548.0

AN ELLIPTIC CONE OF INTERNAL REFRACTION FOR QUASI-TRANSVERSE WAVES IN TETRAGONAL CRYSTALS.
See Abstr. 7588

534.26

7900. ON THE INTENSITY OF ULTRASONIC BEAMS DIFFRACTED BY A WIRE GRATING.
G.M.Sreekantath and C.A.Verghese.
J. Acoust. Soc. Amer., Vol. 31, No. 5, 633-4 (May, 1959).

A theoretical investigation of diffraction of plane waves by a transmission grating shows that the expressions for the intensity of a given order of diffracted beam are not the same for light and sound waves. The latter is $\cos^2\theta$ times the former, where θ is the angle of diffraction. This result has considerable effect on the relative distribution of intensity among the various orders in the two cases. The foregoing theoretical result is verified experimentally in the case of high-frequency sound waves in a liquid diffracted by a wire grating immersed in the liquid.

534.321:9

7901. ULTRASONIC ABSORPTION MICROSCOPE.
F.Dunn and W.J.Fry.
J. Acoust. Soc. Amer., Vol. 31, No. 5, 632-3 (May, 1959).

This paper constitutes a progress report on the development of an ultrasonic instrument for detecting microstructure. The principle of operation of the device (designated by the term "ultrasonic microscope") is as follows: The specimen is imbedded in a liquid, which closely matches it in acoustic impedance, and is irradiated with short pulses of high-frequency sound. Some of the ultrasonic energy is absorbed in the specimen and the remainder leaves is and excites a small thermoelectric probe placed immediately adjacent to the region being investigated. As the specimen, which is between the sound source and the probe, is moved in a direction normal to the direction of sound propagation, a varying acoustic signal will be detected by the probe. This is a consequence of the fact that the amount of acoustic energy absorbed by the specimen in the portion immediately adjacent to the probe is determined by the structure of that part of the specimen. Preliminary experimental results obtained with such a "microscope" operating at a frequency of 12 Mc/s are presented.

534.39

7902 EFFECT OF GAS CONTENT IN MEDIA ON ULTRASONIC CLEANING. L.G.Larson and E.D.Berglund.
J. Acoust. Soc. Amer., Vol. 31, No. 2, 247-8 (Feb., 1959).

The measurement of ultrasonic cleaning as a function of the gas content of the media is described. A positive relationship between cleaning and gas content is noted.

534.39

7903. IMBEDDED THERMISTOR FOR BOUNDARY LAYER MEASUREMENTS. R.K.Gould and W.L.Nyborg.
J. Acoust. Soc. Amer., Vol. 31, No. 2, 249-50 (Feb., 1959).

A technique, involving use of a thermistor imbedded in a plane surface, is described for measuring viscous heating and microstreaming in acoustic boundary layers.

534.39 : 541.14

7904. SONICALLY INDUCED MICROSTREAMING APPLIED TO A SURFACE REACTION.
W.L.Nyborg, R.K.Gould, F.J.Jackson and C.E.Adams.
J. Acoust. Soc. Amer., Vol. 31, No. 6, 706-11 (June, 1959).

Special arrangements are used to produce small-scale eddying near surfaces at which reactions are taking place. Experiments in which the reaction involves a photographic emulsion acted upon by developer show that the development process is considerably accelerated in small areas where the near-surface flow is concentrated. Resonant gas bubbles appear to be by far the most efficient sources of sonically induced micro-eddying. When such a bubble rests on an emulsion surface the development reaction in its neighbourhood is significantly affected, evidently because of the local "microstirring", at ambient pressure amplitudes much less than are typically used in sonic and ultrasonic applications. Sonic microstreaming, especially as induced near resonant bubbles at boundaries, appears to be an important mechanism in accounting for certain well-known effects of ultrasound. Continued development may lead to means for applying microstreaming to surface processes in a controlled and specifiable manner.

534.39

7905. THERMAL EFFECTS OF ACOUSTIC STREAMING NEAR A CYLINDRICAL OBSTACLE. C.T.Walker and C.E.Adams.
J. Acoust. Soc. Amer., Vol. 31, No. 6, 813-14 (June, 1959).

The cooling effect of acoustic streaming on a heated thermistor imbedded in a cylinder placed in a sound field in air was studied and found to be in accord with theory.

534.41

7906. HOT WIRE METHOD FOR VISUALIZING INTENSE STATIONARY SOUND WAVES. R.M.Fand and J.Kaye.
J. Acoust. Soc. Amer., Vol. 31, No. 6, 810-11 (June, 1959).

A simple method was developed for visualizing intense stationary sound waves, using a thin electrically heated wire stretched in the direction of sound propagation. The nodes and antinodes of the sound waves appear as a series of alternate incandescent and dark areas on the wire. Photographs of the hot wire indicate the presence of hitherto unreported thermoacoustic phenomena.

534.44 : 534.77

7907. DEVELOPMENT OF APPARATUS FOR THE ANALYSIS OF SOUND BY THE SENSE OF TOUCH. R.W.Guelke and R.M.J.Huyssen.
J. Acoust. Soc. Amer., Vol. 31, No. 6, 799-809 (June, 1959).

An apparatus is described that applies the frequency components of speech, as spoken into a microphone, to the fingers of one hand with the purpose of enabling a deaf person to comprehend speech. Frequency is indicated by position along the fingers. The sense of touch is not called upon to make any direct frequency discrimination by distinguishing vibrational sensations of different frequencies as in previous attempts of this nature (see Abstr. 148 of 1928). The frequency analysis is done partly electrically and partly mechanically. Small tuned steel reeds are used for the final frequency analysis. These steel reeds also serve as transducers by operating directly against the fingers. The results of a short series of experiments on a deaf person are promising but the recognition of individual consonants is difficult.

534.614 : 621.317.39

7908. A SYSTEM FOR THE ACCURATE DETERMINATION OF ULTRASONIC VELOCITY IN SOLIDS. R.L.Forgacs.
Proc. Nat. Electronics Conf., Vol. 14, 528-43 (1958).

The design of a pulse-echo type system for accurate measurement of ultrasonic velocity in solids is presented. The time jitter in the thyratron transmitting tube was reduced to a fraction of a millimicrosecond by employment of a secondary-emission tube regenerative driver and other techniques. Travel time measurements accurate to approximately one part in 10^5 are feasible. Transmit pulse breakthrough problems are minimized by employment of a clipper circuit utilizing gold bonded germanium diodes. Sample attenuation measurements are also possible.

534.7

PHYSIOLOGICAL ACOUSTICS. HEARING. See also the Section entitled "BIOPHYSICS. PHYSIOLOGICAL PHYSICS".

534.781

7909. SYNTHESIS AND PERCEPTION OF NASAL CONSONANTS. K.Nakata.
J. Acoust. Soc. Amer., Vol. 31, No. 6, 661-6 (June, 1959).

The generation of nasal consonants can be simulated approximately by a cascade connection of simple electrical tuned circuits excited by a quasi-periodic electrical buzz source. The lowest resonance for nasal consonants is in the vicinity of 200 to 300 c/s, and the damping of this resonance is greater than that for the first resonance of vowels. A terminal-analogue synthesizer and control device were used to generate a number of synthetic syllables, each consisting of a nasal consonant followed by a vowel, with smooth formant transitions between consonant and vowel portions. Systematic listening tests have shown that the identification of the nasal consonant is determined largely by the frequency position of the second resonance of the nasal portion of the syllable, and thus by the direction and extent of the second formant transition of the vowel, as noted in other studies. The identification of the nasal consonant is also dependent to some extent on the duration of the consonant and transition portions of the syllable. Isolated nasal consonants generated by this procedure can also be identified with reasonable consistency.

534.781

7910. NATURE OF THE VOCAL CORD WAVE. R.L.Miller.
J. Acoust. Soc. Amer., Vol. 31, No. 6, 667-77 (June, 1959).

The shape of the vocal cord wave is an important parameter in a true analogue representation of the vocal mechanism, since the final speech wave is a function of both the generator wave shape and the transfer impedance of the vocal tract. The shape of this wave was determined by two independent methods: (1) by the derivation and use of a network having a characteristic which is the inverse of the first vocal resonance, and (2) by measuring the area of the vocal cord opening as a function of time through the use of motion picture studies. Harmonic analysis of some of the typical shapes obtained indicate that a uniform distribution of harmonic amplitudes is a rarity; instead there is a tendency for the distribution to have a cyclical variation of the form ($\sin kn/kn^2$). The results obtained through the use of the inverse network indicate that the main excitation of the higher resonances occurs at the point of vocal cord closure and that the magnitude of this excitation can be controlled by the talker over wide ranges.

534.79

7911. LOUDNESS OF COMPLEX SOUNDS AS A FUNCTION OF THE NUMBER OF COMPONENTS. B.Scharf.
J. Acoust. Soc. Amer., Vol. 31, No. 6, 783-5 (June, 1959).

The loudness of complex sounds was studied as a function of the number of components. Complexes of two, three, four, and eight tones, and a band of white noise were matched in loudness to a 1500-cy tone. The overall spacing, ΔF, between the lowest and highest components of these stimuli was held constant at either 175, 1600, or 3400 c/s. All the complexes were centred around 1500 c/s when ΔF was either 175 or 1600 c/s. At each of the four levels tested (25, 50, 75, and 90 dB SPL), loudness remained essentially unchanged when only the number of components within a complex was varied. This invariance of loudness occurs even though inhibition may be greater within the complexes that contain a larger number of components. It is suggested that the increased inhibition may be offset by greater loudness summation when the energy is more evenly distributed within the complexes.

534.845

7912. A CORRELATION METHOD OF MEASUREMENT OF THE ACOUSTIC RATIO. S.G.Gershman and E.F.Orlov.
Akust. Zh., Vol. 3, No. 3, 285-8 (1957). In Russian.

The acoustic ratio is the ratio of the r.m.s. intensities of the emitted signal (corrected for absorption, etc.) and the received signals in a room or a hall. A direct method of measurement of the acoustic ratio is described and some results given for a particular room.

534.846

7913. NEW WALL DESIGN FOR HIGH TRANSMISSION LOSS OR HIGH DAMPING. G.Kurtze and B.G.Watters.
J. Acoust. Soc. Amer., Vol. 31, No. 6, 739-48 (June, 1959).

A typical single wall is characterized by a free flexural wave speed, c_B, which increases with $\omega^{1/2}$. When c_B approaches c_0 (the speed of sound waves in the surrounding medium) the impedance of the wall to incident sound wave ceases to be mass-like because of the coincidence effect and the transmission loss will be less than that given by mass law. Since $c_B = (B/M)^{1/4}(\omega)^{1/2}$ for homogeneous walls, the deleterious effects of the coincidence of the flexural wave speed with the phase velocity of sound in the medium can be avoided for homogeneous walls by reducing the ratio of B/M. (B is the dynamic bending stiffness of the wall; M is the mass per unit area of the wall). Thus the problem of good acoustical performance in homogeneous walls is seen to be in essential conflict with the need for structural rigidity. A new wall design was found in which the ratio of the static to the dynamic stiffness can be in excess of 1000 : 1 and where the stiffness changes from the static to the dynamic value in such a way that the acoustical behaviour is nearly that of a perfectly limp wall. If desired, the loss tangent of the wall can be made large and nearly constant over a wide range of frequencies.

534.88

7914. A THEORY OF ACTIVE SONAR DETECTION.
J.L.Stewart and E.C.Westerfield.
Proc. Inst. Radio Engrs, Vol. 47, No. 5(I), 872-81 (May, 1959).

The results of a theory of echo detection developed for radar are extended to sonar for the case of narrow-band transmitted signals. The exposition specifically omits discussion of the decision problem and the statistical nature of the whole process of detection. The theory assumes that the received signal is processed by cross correlation with a normalized replica of the expected signal. The problem of echo to noise is analysed by sampling theory leading, in the case of Gaussian noise, to the energy principle which states that in all cases the output echo-to-noise ratio is the ratio of the input signal energy to the input noise power spectrum density. The threshold effect in detection is briefly discussed in conjunction with the problem of noise ambiguities. The problem of echo to reverberation (clutter) is treated by the use of the time and frequency shift correlation function leading to the ambiguity diagrams for various waveforms. The calculation of the relative reverberation power for short and long pulses of single frequency, FM and pseudorandom or noise-like waveforms for certain special cases is presented to illustrate the application of these principles. The paper concludes with a discussion of some limitations to the theory in terms of its narrow-band approximation, the instability of platforms and medium, and combined space-time ambiguities.

OPTICS . SPECTRA . LUMINESCENCE

535.13 : 538.569

INTERACTIONS OF ELECTROMAGNETIC RADIATION WITH MATTER AND SPECTRAL LINE SHAPES PRODUCED.
See Abstr. 7220

535.14

7915. THE FLUCTUATIONS OF INTENSITY OF AN EXTENDED LIGHT SOURCE. L.Jánossy.
Nuovo Cimento, Vol. 12, No. 4, 369-84 (May 16, 1959).

Extending previous calculations (Abstr. 8499 of 1957), the present paper deals with the exact statistics of the fluctuation of wave trains emitted by a source the extension of which cannot be neglected. As before the individual wave trains are supposed to decay exponentially, however, it is assumed here that the individual trains have different frequencies, intensities and polarization. Various experimentally observed effects, among them that obtained with the stellar interferometer by Hanbury Brown and Twiss can be quantitatively accounted for.

535.214.4

7916. CONVECTIVE RADIOMETER.
V.Nadolschi and C.Tomozei.
An. Stiint. Univ. "Al. I. Cuza", Iasi I (Ser. noua), Vol. 3, No. 1-2, 217-24 (1957). In Roumanian.

A novel system for the measurement of the radiometric pressure of sunlight is described which differs mainly from classical methods by its independence of vacuum techniques and the ray's angle of arrival. A blackened sphere is illuminated and produces an air convection current in a vertical glass tube; suspended above, on a torsion thread, is a rotating assembly of paddles. The apparatus, its construction, with variants, and its calibration are described in some detail. A high order of sensitivity is obtainable. A.Reiss

535.245

7917. SIMPLE WAY OF MEASURING THE [ABSOLUTE] POWER OF HIGH-INTENSITY LIGHT BEAMS. W.F.Flood.
Rev. sci. Instrum., Vol. 30, No. 6, 487-8 (June, 1959).

The method requires only the measurement of the temperature of a known mass as a function of time. Measurements are shown to be accurate with a few per cent.

535.245.1

7918. INTEGRATOR FOR DETERMINING THE ILLUMINATION DISTRIBUTION IN THE IMAGE OF AN OBJECT OF GIVEN SHAPE.
R.Prat and Y.Mercier.
Rev. Opt., Vol. 36, No. 4, 177-86 (April, 1957). In French.

The instrument is based on the fact that the illumination at any point in the image is given by the volume of the solid of diffraction. This volume is determined electrically by passing a curve, representing the outline of the object, across a uniformly illuminated slit and collecting the light on the cathode of a photo-multiplier cell.
J.W.T.Walsh

535.31

7919. ON THE COMPUTATION OF WAVEFRONTS. F.I.Havlìček.
Optica Acta, Vol. 3, No. 3, 147 (1956). In German.

Series for the Cartesian coordinates of the wavefront are obtained from a series for the longitudinal spherical aberration. The coefficients are given by recurrence relations starting from the lower order coefficients. W.T.Welford

535.31

7920. ON THE COMPUTATION OF WAVEFRONTS. J.Picht.
Optica Acta, Vol. 4, No. 2, 77-8 (June, 1957). In German.

Claims that the recurrence relations for wavefront coefficients in terms of ray aberration coefficients for spherical aberration given by Havlicek (see preceding abstract) offer no advantage over equivalent relations given by Picht (Abstr. 3599 of 1956). Extensions to the recurrence relations are given to include meridional coma.
W.T.Welford

535.317

7921. ON WAVE-OPTICAL IMAGERY IN SYSTEMS WITH LARGE RELATIVE APERTURE. J.Focke.
Optica Acta, Vol. 4, No. 4, 124-6 (Dec., 1957). In German.

An approximate solution of the problem of the image of a point source by a system of large numerical aperture. The light amplitude is represented by a scalar u and the light intensity (unpolarized) is taken as $\frac{1}{2}(uu^* + k^{-2}\,\mathrm{grad}\,u.\,\mathrm{grad}\,u^*)$ where $k = 2\pi/\lambda$, following Green and Wolf. Numerical results are given for semi-angles of the imaging beam up to 90 degrees. W.T.Welford

535.317.1

7922. THE FORMATION OF IMAGES OF INTERFERENCE EFFECTS AND IMAGE DEFECTS. E.G.Kind and G.Schulz.
Optik, Vol. 16, No. 1, 2-13 (Jan., 1959). In German.

Treatment is given for the image formation of two-beam interference fringes by optical systems. Two different methods of construction of the image are discussed and resulting aberrations considered. Differences between the two methods vanish in certain limiting cases. Diffraction and incoherence in the source are disregarded. S.Tolansky

535.317.1

7923. OPTICAL IMAGERY AND COHERENCE, A DEMONSTRATION EXPERIMENT. M.Czerny.
Optik, Vol. 16, No. 3, 129-31 (March, 1959). In German.

An image is formed by a lens of which the aperture is scanned by a Nipkow disk, so that the "rays" meet the image plane at different instants of time. The image is degraded, showing that the correct phase relationships between different parts of the aperture are essential to sharp imagery. W.T.Welford

535.317.1

7924. TOTAL ILLUMINATION IN AN ABERRATION-FREE DIFFRACTION IMAGE.

J.Focke.

Optical Acta, Vol. 3, No. 4, 161-3 (Dec., 1956).

Asymptotic expressions are derived for the total illumination in a defocused aberration-free diffraction image based on the asymptotic approximations of the diffraction integral due to Schwarzschild or to van Kampen, respectively.

535.317.1

7925. QUALITY EVALUATIONS OF OPTICAL SYSTEMS.

E.H.Linfoot.

Optica Acta, Vol. 5, No. 1-2, 1-14 (March-June, 1958).

Definitions of three evaluations, (1) relative structural content, (2) fidelity and (3) correlation quality, given previously (Abstr. 7254/1956) for monochromatic isoplanatism patches, are extended to finite polychromatic fields. A generalization of Strehl definition for such fields is proposed and a relation between this and (3) is given. W.T.Welford

535.317.25

7926. ENERGY THEORY OF RESOLVING POWER.

V.Ronchi.

Acta Electronica, Vol. 2, No. 1-2, 37-43 (1957-58). In French.

"Physical problems of colour television" Conference paper (see Abstr. 1006 of 1958). An historical survey demonstrating the emergence of the concept of resolving power as a function of instrument design, light intensity and receptor properties. Experimental results are given to show the dependence of visual resolution of a double star by a telescope on magnification and brightness. W.T.Welford

535.317.3

7927. SIMULTANEOUS MINIMIZATION OF CHROMATIC AND SPHERICAL ABERRATIONS.

P.M.Ross and R.Hanau.

J. Opt. Soc. Amer., Vol. 49, No. 3, 308-9 (March, 1959).

Design of a plano-convex F/3 collimator with annular colour filters in contact with the plane surface so that longer wavelengths are transmitted further from the axis. In this way spherical and chromatic aberration cancel each other. W.T.Welford

535.317.7

7928. THE MOIRÉ FRINGE SYSTEM AS A VERSATILE TEST-OBJECT: PHOTOELECTRIC MEASUREMENT OF ABERRATIONS.

A.Lohmann.

Optica Acta, Vol. 6, No. 1, 37-41 (Jan., 1959). In German.

Proposal for a device in which two gratings in relative rotation provide a moiré pattern of variable spacing which is imaged by the lens under test on to a slit backed by a photomultiplier. At the same time the gratings produce a diffraction pattern, consisting mainly of three coherent maxima, which scans across the lens aperture as the gratings rotate. An a.c. signal is obtained in which the amplitude is related to the Twyman—Green pattern of the lens. Other applications of the device as an analogue Fourier transformer, for thin film measurements and for spectrophotometry are suggested. W.T.Welford

535.317.8

7929. UNIT MAGNIFICATION OPTICAL SYSTEM WITHOUT SEIDEL ABERRATIONS.

J.Dyson.

J. Opt. Soc. Amer., Vol. 49, No. 7, 713-16 (July, 1959).

A unit magnification system is described which is free from Seidel aberrations and which can be used at very high aperture. The leading higher order aberrations are derived. A method using this system for reproducing photographically small groups of lines with a spacing of 6000 lines/in. is described. Several other possible applications of the system are outlined.

535.318

7930. THE CHOICE OF THE THREE COMPONENTS IN A CEMENTED TRIPLET.

J.Pastor Franco.

An. Real Soc. Espan. Fis. Quim., Vol. 55(A), No. 1-2, 37-46 (Jan.-Feb., 1959). In Spanish.

A systematic study is made of the performance of cemented triplet objectives in which the glass for the first and third component is the same. Curves showing the residual aberrations as functions of radii for a variety of glass types are given. Considerations of the optimum glass types are then made. R.W.Fish

535.323

7931. OPTICAL PROPERTIES OF GALLIUM ANTIMONIDE.

D.F.Edwards and G.S.Hayne.

J. Opt. Soc. Amer., Vol. 49, No. 4, 414-15 (April, 1959).

The refractive index of a single crystal in the wavelength range 1.8-2.5 μ was measured by the prism technique and from reflectivity measurements. The values given by the prism method were consistently higher than those deduced from reflectivity data: this discrepancy remains unexplained. Hall effect and resistivity measurements indicated that the GaSb samples were the purest yet reported. B.T.M.Willis

535.323 : 539.21

RADIATION-INDUCED CHANGES OF INDEX OF REFRACTION AND DISPERSION OF LITHIUM FLUORIDE. See Abstr. 7524

535.325

7932. OPTICAL REFRACTIVITY OF HIGH-TEMPERATURE GASES. I. EFFECTS RESULTING FROM DISSOCIATION OF DIATOMIC GASES.

R.A.Alpher and D.R.White.

Phys. of Fluids, Vol. 2, No. 2, 153-61 (March-April, 1959).

Shock-tube and discharge techniques make it possible to generate in the laboratory significant volumes of dissociated and/or ionized gases. This paper describes some studies of the optical index of refraction μ of dissociated diatomic gases. The physical interpretation of specific refractivity $K = (\mu - 1)/\rho$ is discussed and related to polarizability, and various methods of computing such quantities are reviewed briefly. Shock-tube experiments are described in which optical interferometry has been utilized to measure the polarizability of atomic oxygen and nitrogen with the result $\alpha(\mathrm{O\ I}) = 0.77 \pm 0.06\ \mathrm{A}^3$ and $\alpha(\mathrm{N\ I}) = 1.13 \pm 0.06\ \mathrm{A}^3$. The use of optical interferometry for determination of gas density was justified for experiments involving air at temperatures to at least 5000°K.

535.325

7933. OPTICAL REFRACTIVITY OF HIGH-TEMPERATURE GASES. II. EFFECTS RESULTING FROM IONIZATION OF MONATOMIC GASES.

R.A.Alpher and D.R.White.

Phys. of Fluids, Vol. 2, No. 2, 162-9 (March-April, 1959).

This paper describes shock-tube studies of the optical index of refraction of ionized argon in which observed optical effects were related to the ionization of the shocked argon. The plasma dispersion formula was applied to the measured refractivities to determine values of equilibrium electron concentrations on the order of 10^{17} cm^{-3}. Good agreement is found between experimental and calculated values of the degree of ionization. The ionization relaxation process is strikingly portrayed in the interferograms and may be studied in some detail. Some questions concerning proposed kinetics for the relaxation behind strong shock waves in monatomic gases are discussed.

535.327 : 535.81

VARIATION OF THE REFRACTIVE INDEX OF GLASS WITH TEMPERATURE. See Abstr. 6815

535.33

7934. APPARENT SEPARATION AND INTENSITY RATIO OF CLOSE SPECTRAL LINES.

K.C.Chaturvedi.

Indian J. Phys., Vol. 31, No. 5, 247-55 (May, 1957).

The relationship is discussed between the true separation (a), true intensity ratio (b) and apparent separation (a') and apparent intensity ratio (b') when (i) instrumental line width is negligible and (ii) when natural line width is negligible. Graphs are given to corre for shrinkage effect.

535.33.03

7935. BEHAVIOR OF THE D.C. IRON ARC AND ITS USEFULNES IN THE DETERMINATION OF f VALUES.

R.Hefferlin.

J. Opt. Soc. Amer., Vol. 49, No. 7, 680-5 (July, 1959).

Measurements of iron arc spectra have been made with Pachen—Runge spectrographs and a specially designed photoelectri photometer of the a.c. ratio type allowing continuous scanning and recording. The temperature and self-absorption present in differen parts of the arc, and in the arc under different operating conditions, have been determined, and are presented for use in determining which lines are self-absorbed under given conditions. Some unexplained mechanism in the arc causes deviation from equilibrium values of the intensities of all lines within multiplet 68. This mechanism does not operate in the furnace. Corrected values are given for some f values given in the literature. Additional measurements of the arc are now under way for the calculation of high-excitation f values.

535.33.07

7936. DISTORTION OF SPECTRAL LINES IN MIRROR MONOCHROMATORS. I.V.Peisakhson.
Optika i Spektrosk., Vol. 4, No. 4, 481-5 (April, 1958). In Russian. English summary: PB 141047T-9, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

The image of a narrow rectilinear slit in a prism spectrometer is approximately paraboloid in shape, but an entrance slit of radius of curvature r_0 gives a straight image at a certain wavelength. Formulae are given for calculation of curvatures of lines produced by prisms and diffraction gratings. In an autocollimating monochromator with a plane reflecting grating, and including a parabolic mirror off the optical axis, rectilinear slits will give straight images. S.T.Henderson

535.33.07

7937. DOUBLE FOCUS LENS AND MIRROR MONOCHROMATOR. Yu.V.Mal'tsev.
Optika i Spektrosk., Vol. 4, No. 4, 506-12 (April, 1958). In Russian. English summary: PB 141047T-9, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

The usual central disphragm is replaced by a cylindrical reflecting surface with its axis coincident with the optical axis of the system. It is surrounded by a circular diaphragm to provide a ring-shaped slit. This device reduces the astigmatism of oblique rays. There are two pairs of plano-convex condenser lenses instead of prisms, and only the peripheral parts of these lenses are used. To illuminate the entrance aperture and transmit light through the exit aperture, toroidal or paraboloidal mirror-lens condensers are used. In the transmission of monochromatic light and width of band transmitted this instrument is intermediate in performance between a prism monochromator and glass filters. S.T.Henderson

535.331

7938. EXTINCTION OF THE RESONANCE LINE OF MERCURY λ = 2537 A UNDER THE ACTION OF A NUMBER OF FOREIGN GASES. J.L.Cojan and Y.Lécluse.
C.R. Acad. Sci. (Paris), Vol. 247, No. 25, 2325-7 (Dec. 22, 1958). In French.

The extinction cross-section σ^2 of the resonance line of mercury has been found to be 10.2 A^2 (for O_2); 5.5 A^2 (for H_2); 26 A^2 (for NO_2); 0.0 A^2 (for N_2). R.W.Nicholls

535.331

7939. COMPILATION OF DATA ON SOME SPECTRA OF THORIUM. G.W.Charles.
J. Opt. Soc. Amer., Vol. 48, No. 11, 859 (Nov., 1958).

A compilation of all previously published, and some unpublished, data on the spectra of Th I, Th II, Th III, Th IV, has been issued as a technical report (ORNL-2319) by the Oak Ridge National Laboratories. This report does not include the current work of C.C.Keiss and R.Zalubus of the National Bureau of Standards. R.W.Nicholls

535.332

7940. REMEASURED CARBON I WAVELENGTHS IN THE PHOTOGRAPHIC INFRARED. L.Minnhagen.
Ark. Fys., Vol. 14, Paper 30, 481-2 (1958).

Some 7 lines in the range 1.068-1.133 μ are measured with a precision of 0.02 A. G.F.Lothian

535.332

7941. EMISSION SPECTRA OF ARGON AND OF NEON BETWEEN 2 AND 2.5 μ. G.Hepner.
C.R.Acad. Sci. (Paris), Vol. 248, No. 8, 1142-5 (Feb. 23, 1959). In French.

Wavelengths and classifications are given for 24 infrared lines of argon and 26 infrared lines of neon excited in a Geissler tube over the wavelength range 2-2.5 μ. R.W.Nicholls

535.332

7942. VACUUM ULTRAVIOLET CONTINUUM EMISSION IN NEON. W.Roth.
J. Opt. Soc. Amer., Vol. 48, No. 12, 1018 (Dec., 1958).

A step in the process by which the intensity of the continuum is increased in the presence of N_2 is the transition

$$Ne(^1P_1) + N_2(v = 0) \rightarrow Ne(^3P_2) + N_2(v = 1)$$

for which there is a fairly exact energy balance. G.F.Lothian

535.333

7943. THE LYMAN BANDS OF MOLECULAR HYDROGEN. G.Herzberg and L.L.Howe.
Canad. J. Phys., Vol. 37, No. 5, 636-59 (May, 1959).

The Lyman bands of H_2 have been investigated under high resolution with a view to improving the rotational and vibrational constants of H_2 in its ground state. Precise B_v and ΔG values have been obtained for all vibrational levels of the ground state. One or two of the highest rotational levels of the last vibrational level ($v = 14$) lie above the dissociation limit. Both the B_v'' and $\Delta G''$ curves have a point of inflection at about $v'' = 3$. This makes it difficult to represent the whole course of each of these curves by a single formula and therefore makes the resulting equilibrium constants somewhat uncertain. This uncertainty is not very great for the rotational constants found —

$$B_e = 60.864, \quad \alpha_e = 3.0764\ \text{cm}^{-1},$$

but is considerable for the vibrational constants ω_e and $\omega_e x_e$ for which three-, four-, five-, and six-term formulae give results diverging by $\pm 1\ \text{cm}^{-1}$. The rotational and vibrational constants for the upper state ($B\ ^1\Sigma^+$) of the Lyman bands are also determined. An appreciable correction to the position of the upper state is found.

535.333 : 539.19

7944. ELECTRONIC QUENCHING OF $OH(^2\Sigma^+)$ IN FLAMES AND ITS SIGNIFICANCE IN THE INTERPRETATION OF ROTATIONAL RELAXATION. T.Carrington.
J. chem. Phys., Vol. 30, No. 4, 1087-95 (April, 1959).

The quenching of fluorescence of electronically excited $OH(^2\Sigma^+)$ molecules in the burnt gases above a lean acetylene—oxygen flame burning at a pressure of 3.5 mm Hg was measured for resolved rotational lines. From these data the lifetime in this flame of the $^2\Sigma^+$ state with respect to electronic quenching collisions is found to be 0.45×10^{-7} sec, about one-tenth of the radiative lifetime of the free molecule. Quenching measurements as a function of pressure and composition give cross-sections for quenching by O_2, CO_2, and H_2O of 7, 16, and 35 A^2. These values exceed by a factor of 10 or more the cross-sections to be expected for simple exchange of rotational with translational energy. For argon the quenching cross-section is less than 2 A^2. The large cross-sections for quenching by the flame gases, and the resultant short lifetime of electronically excited OH molecules in the flame, mean that these molecules undergo a radiationless loss of electronic energy in collisions before they have time for either a radiative transition or a collision leading to simple rotational energy transfer. The rotational distribution in the electronic spectrum emitted by OH in flames is thus determined almost exclusively by collision processes involving transfer of electronic energy. Rotational temperatures derived from these distributions bear in general no direct relation to the translational or rotational temperatures which may be associated with the other species in the flame, and are determined principally by specific excitation processes.

535.333

7945. NEW EMISSION BANDS OF N_2 IN THE VACUUM ULTRAVIOLET REGION. M.Ogawa and Y.Tanaka.
J. chem. Phys., Vol. 30, No. 5, 1354-5 (May, 1959).

Six new emission bands of N_2 are reported between 1600 A and 2050 A and their possible origin is discussed. R.D.Hudson

535.337 : 538.27 : 537.311.33

7946. THEORY OF IMPURITY PHOTO-IONIZATION SPECTRUM OF SEMICONDUCTORS IN MAGNETIC FIELDS. R.F.Wallis and H.J.Bowlden.
J. Phys. Chem. Solids, Vol. 7, No. 1, 78-89 (Oct., 1958).

The impurity photo-ionization magneto-optic (IPMO) effect is the effect of an external magnetic field on the optical photo-ionization spectrum of impurities in semiconductors. A theory of the IPMO effect has been developed for simple semiconductors. Two cases can be distinguished, depending on whether the impurity ionization energy for zero field is larger or smaller than $\frac{1}{2}\hbar\omega_c = \hbar eH/2m^*c$. In the low-field case, the photo-ionization spectrum consists of a series of rather strong peaks corresponding to transitions from bound levels to the various magnetic sub-bands of the continuum. In the high-field case, the photo-ionization spectrum consists of one, or at most two, strong peaks if the temperature is such that only the lowest bound level is appreciably occupied. Detailed calculations are presented of the high-field absorption spectrum for donor impurities in InSb, based on wave functions similar to those of Yafet, Keyes and Adams (1956).

535.337

7947. OSCILLATORY MAGNETO-ABSORPTION IN GALLIUM ANTIMONIDE JA-1149.

S.Zwerdling, B.Lax, K.J.Button and L.M.Roth.

J. Phys. Chem. Solids, Vol. 9, No. 3-4, 320-4 (March, 1959).

High-resolution magneto-absorption measurements made at photon energies just above the intrinsic absorption edge in GaSb have revealed an oscillatory spectrum having a strong resemblance to the corresponding spectrum for direct transitions in germanium. Eight successive transmission minima were observed in magnetic fields up to 38.9 kG at both 1.5 and 4.2°K, using polarized incident radiation. The value of the energy gap found is $\mathcal{E}_g = 0.813 \pm 0.001$ eV and is shown to be attributable to direct transitions of electrons between the valence and conduction bands. The electron effective mass, $m^* = (0.047 \pm 0.003)m_0$, was determined by considering transitions from the heavy holes to the conduction band and employing the data of the $E \parallel B$ spectrum. The existence of fine structure, although not resolved, is indicated by the unsymmetrical character of some of the transmission minima. The first absorption line is believed to contain exciton absorption. The inability to resolve the fine structure and exciton absorption is attributed to line broadening and overlapping due chiefly to scattering by the high impurity density in the sample.

535.34

7948. RELATIVE INTENSITIES OF ABSORPTION BANDS IN LIQUID AND GAS PHASES FROM DISPERSION THEORY.

E.E.Ferguson.

J. chem. Phys., Vol. 30, No. 4, 1059-60 (April, 1959).

The well-known expression for the ratio of liquid—gas intensities of absorption bands is derived from the point of view of dispersion theory which shows clearly several assumptions implicit in the expression, the most important being the restriction to weak bands. The manner in which liquid and gas oscillator strengths can be determined from liquid dispersion data is discussed and the infrared dispersion data of CS_2 is analysed in this way.

535.34.03

7949. HIGH-INTENSITY LOW-PRESSURE MERCURY VAPOUR LAMPS FOR RAMAN SPECTROSCOPY.

G.Schreiber.

Optik, Vol. 15, No. 12, 724-33 (Dec., 1958). In German.

Lamps have been constructed with water cooled electrodes, in elongated and in Toronto form. For λ 4358 A, curves of line contour and intensity against current are shown. The component due to the even isotopes accounts for 70% of the intensity and has a width of 0.07 cm^{-1}. G.F.Lothian

535.34.07 : 621.317.36

7950. THEORY OF THE CAVITY MICROWAVE SPECTROMETER AND MOLECULAR FREQUENCY STANDARD.

Y.Beers.

Rev. sci. Instrum., Vol. 30, No. 1, 9-16 (Jan., 1959).

A short section of a waveguide is considered as a nonresonant absorption cell and then as a resonant cavity. It is shown that the latter gives a better signal-to-noise ratio by a factor which depends upon the relative intensity of the various noise sources but which increases with the Q. It is shown that the voltage signal-to-noise ratio is proportional to the square root of the product of the volume and the Q, and otherwise is independent of the shape. This result leads to the conclusion that it is possible in theory to build microwave spectrometers having signal-to-noise ratios some 50 dB larger or capable of detecting absorption coefficients some 300 times smaller than spectrometers which are now widely used. However, practical considerations probably would prevent this advantage from being realized completely. These results are applied to a frequency standard using an absorption line. It is shown that it is possible to build a standard using the 3,3 line of NH_3 with a fractional stability of about 4×10^{-12} over an extended interval of time. Some discussion of spectrometers with long nonresonant cells is also included.

535.34.07

7951. THE MEASUREMENT OF THE ABSOLUTE INTENSITIES OF ABSORPTION LINES.

T.M.Murina, A.M.Prokhorov and É.A.Chayanova.

Radiotekhnika i Elektronika, Vol. 3, No. 11, 1402-4 (Nov., 1958). In Russian.

A method of measuring the absorption coefficients of spectral lines in microwave spectroscopy by using a ferrite modulator in conjunction with a Stark modulator is suggested. A ferrite modulator constructed for this purpose is described and its use for absorption measurements discussed. R.C.Glass

535.343

7952. ULTRAVIOLET AND INFRARED ABSORPTION OF FUSED GERMANIA.

A.J.Cohen and H.L.Smith.

J. Phys. Chem. Solids, Vol. 7, No. 4, 301-6 (Dec., 1958).

Fused GeO_2 contains an intense absorption band centred at 2445 A and caused by a reduced germanium species, probably Ge(II). This band has a half-width comparable to that of a band centred at 2429 A in certain fused silicas and produced by the same reduced germanium species contained as an impurity. The band in germania is bleached by ultraviolet light and X-rays accompanied by an increase in absorbency below 2200 A. The energy gap for fused germania is slightly higher than a value published for hexagonal germanium dioxide, which indicates the latter is probably in error. The infrared spectrum of fused germania is also presented.

535.343 : 538.2

7953. SOME OPTICAL AND MAGNETIC PROPERTIES OF IRRADIATED LiF.

R.T.Bate and C.V.Heer.

J. Phys. Chem. Solids, Vol. 7, No. 1, 14-21 (Oct., 1958).

The optical oscillator strength of the F-band in LiF is determined as $f_L = 0.82$ from combined optical and magnetic measurements on X-irradiated and neutron-irradiated samples. The numbe of F-centres formed in LiF as a function of neutron dosage was measured over a broad range of dosage by either optical or magnetic techniques. The formation of F-centres saturates in the vicinity of 8×10^{19} centres/cm^3; and saturation occurs for neutron dosages considerably smaller than those required for saturation of vacancies and interstitials. Experimental evidence is presented to indicate that F-centres are separated by more than six lattice units in the most densely coloured samples.

535.343 : 537.561

ABSORPTION COEFFICIENTS OF NITROGEN DIOXIDE.

See Abstr. 7118

535.343

7954. NEAR ULTRAVIOLET ABSORPTION SPECTRUM OF CRYSTALLINE 1,3,5-TRICHLOROBENZENE.

O.Schnepp.

J. chem. Phys., Vol. 30, No. 4, 863-7 (April, 1959).

The absorption spectrum of single crystals in polarized light was investigated at 4.2°K. The spectrum was found to consist of a forbidden molecular part and an allowed crystal field induced syste The two parts of the spectrum are characterized by different polarizations and the polarization behaviour of the molecular spectrum leads to conclusions concerning the orientations of the molecular planes in the crystal.

535.343

7955. NEAR ULTRAVIOLET SPECTRUM OF CRYSTALLINE HEXACHLOROBENZENE.

O.Schnepp and R.Kopelman.

J. chem. Phys., Vol. 30, No. 4, 868-73 (April, 1959).

The spectrum of single crystals of hexachlorobenzene in polarized light was investigated at liquid nitrogen and liquid helium temperatures, in the 3000 A region. The absorption spectrum consists of a forbidden benzene-type molecular spectrum with transition moment in the molecular plane and an allowed spectrum base on the 0-0 band which is polarized in a direction close to the molecular normals. This spectrum is concluded to be crystal induced. A prominent band at 790 cm^{-1} from the 0-0 band is assigned as involving the a_{2a} vibrational fundamental and its observation in the b axis polarized component suggests that the molecule is puckered and has symmetry D_{3d} in the crystal.

535.34

7956. NEAR ULTRAVIOLET SPECTRUM OF CRYSTALLINE DURENE.

O.Schnepp and D.S.McClure.

J. chem. Phys., Vol. 30, No. 4, 874-8 (April, 1959).

The absorption and fluorescence spectra of single oriented crystals of durene (symmetric tetramethylbenzene) were photographed at 20°K in the 2800 A region. The ab plane of the crystal was investigated and it was found that the absorption intensity in the two polarization components in this plane was very nearly equal The crystal splitting is less than 3 cm^{-1}. The polarization properties of the absorption require the assignment of B_{2u} for the lowest excited state of the parent molecule, benzene.

535.34

7957. THE EFFECT OF PRESSURE ON THE NEAR-ULTRAVIOLET SPECTRA OF SOME FUSED-RING AROMATIC CRYSTALS

S.Wiederhorn and H.G.Drickamer.

J. Phys. Chem. Solids, Vol. 9, No. 3-4, 330-4 (March, 1959).

The effect of pressure has been studied on the near-ultraviolet and visible absorption peaks of anthracene, phenanthrene, (a,h) dibenzanthracene, and (α) benzanthracene. In general, the effect of pressure is to shift the peaks to the red (lower energy) and to broaden them. The greater shift and broadening were found, in general, for the peaks with the larger transition moments. The total shift cannot be accounted for by the increase in density if only dipole—dipole interactions are considered. There seems to be no measurable increase in integrated intensity, and therefore no increase in transition moment. The most likely cause of the shift (in addition to the dipole—dipole interaction) is increased importance of quadrupole and higher interactions at high pressures.

535.343

7958. PRESSURE-INDUCED LIGAND FIELD PEAK IN K_2ReCl_6.
D.R.Stephens and H.G.Drickamer.
J. chem. Phys., Vol. 30, No. 5, 1364 (May, 1959).

Absorption measurements at pressures up to 50 000 atmospheres on the 14 200 cm^{-1} and 15 700 cm^{-1} bands of K_2ReCl_6 show the appearance of a new peak at 16 100 cm^{-1} at high pressures. The new band is associated with a $^4\Gamma_2 \rightarrow {}^2\Gamma_5$ spin transition.

D.L.Greenaway

535.343 : 534.222.2

GENERATION AND DETECTION OF THE H^--CONTINUUM IN A SHOCK-WAVE TUBE. See Abstr. 7890

535.343

7959. THE EFFECT OF PRESSURE ON THE SPECTRA OF THE Tl^+ ION IN ALKALI HALIDE LATTICES.
R.A.Eppler and H.G.Drickamer.
J. Phys. Chem. Solids, Vol. 6, No. 2-3, 180-3 (Aug., 1958).

The effect of pressure on the spectra of the Tl^+ ion in several alkali halide lattices has been measured to 130 000 atm (in some cases to 50 000 atm). The results can be summarized as follows: (1) In the face-centred cubic lattice, the "A" peak shows a red shift with increasing pressure. The magnitude of the shift is independent of the alkali halide involved. (2) In the simple cubic lattice, the "A" peak shifts blue at low pressures (up to 15 000 atm) and red at high pressures (above about 25 000 atm). (3) At the phase transition in the potassium halides, KCl : Tl and KBr : Tl show a discontinuous blue shift; KI : Tl shows a red shift. (4) The "B" peak appears in CsI : Tl and also appears discontinuously at the transition to the simple cubic lattice in KI : Tl. It shifts blue with pressure. The results are, in most ways, consistent with available theory.

535.343

7960. A HYDROGEN-LIKE SERIES OF LINES IN THE SPECTRUM OF A CADMIUM SULPHIDE CRYSTAL AT THE FUNDAMENTAL ABSORPTION EDGE. E.F.Gross and B.S.Razbirin.
Zh. tekh. Fiz., Vol. 27, No. 6, 1398-9 (June, 1957). In Russian.
English translation in: Soviet Physics — Technical Physics (New York), Vol. 2, No. 6, 1293-4 (June, 1957).

Thin CdS crystals show four strong absorption lines near the absorption edge when polarized light is used (E in plane perpendicular to optical axis of crystal); these lines fall into a hydrogen-like series starting with the term n = 3. The series is thus only found for sufficiently large orbits. The lines are assumed to be characteristic of exciton states, the reduced mass of the exciton being 0.8 m_e.

G.F.J.Garlick

535.343

7961. THE OPTICAL TRANSMISSION SPECTRUM OF BARIUM TITANATE. A.F.Yatsenko.
Zh. tekh. Fiz., Vol. 27, No. 10, 2422-4 (1957). In Russian. English translation in: Soviet Physics — Technical Physics (New York), Vol. 2, No. 10, 2257-8 (Oct., 1957).

The transmission of a single crystal plate 0.25 mm thick was measured from 0.2-23 μ. The specimen showed an absorption edge at 0.4 μ, and lattice absorption at wavelengths longer than 6 μ. There was a weak absorption band at 8 μ, and no transmission was found beyond 11 μ. Experiments with a powdered specimen revealed an absorption band between 15 and 18 μ. This band is ascribed to a titanium ion vibrating in the oxygen octahedron, and the 8 μ band is the first overtone.

C.Hilsum

535.343

7962. THE PRESSURE-INDUCED ROTATIONAL ABSORPTION SPECTRUM OF HYDROGEN. I. A STUDY OF THE ABSORPTION INTENSITIES. Z.J.Kiss, H.P.Gush and H.L.Welsh.
Canad. J. Phys., Vol. 37, No. 3, 362-76 (March, 1959).

The pressure-induced infrared spectrum of H_2 and mixtures of H_2 with N_2, He, Ne, A, Kr, and Xe was measured in the region 300-1400 cm^{-1} at total gas pressures up to 250 atm at 300°K and, where possible, at 195° and 85°K. The spectrum shows greatly broadened S lines ($\Delta J = +2$) with half widths which decrease as the temperature is lowered. The integrated absorption coefficient of the band is of the form $\alpha_1 \rho_{H_2} \rho_f$, where ρ_f is the density of the perturbing gas, except in the case of Xe for which a cubic term, $\alpha_2 \rho_{H_2} \rho_f^2$, is also necessary. The binary coefficient α_1 increases by a factor of 28 in going from He to Xe. The theoretical band intensity, calculated on the basis of quadrupole interaction alone, is in good agreement with the experimental value for only Xe as perturbing gas; in other cases the calculated value is appreciably less than the observed value. The shape of the absorption contours suggests that the S lines are overlaid by a continuum increasing in intensity towards lower frequencies. This continuum is interpreted as the counterpart of the Q_R component in the vibrational band, that is, a collision-induced absorption due to overlap interaction in which the relative kinetic energy of the collision partners changes in the absorption process.

535.343 : 537.311.33

INFRARED ABSORPTION IN N-TYPE GALLIUM ARSENIDE. See Abstr. 6948

535.343

7963. THE $4\nu_2$ BAND OF NITROUS OXIDE.
S.A.Clough, D.E.McCarthy and J.N.Howard.
J. chem. Phys., Vol. 30, No. 5, 1359-60 (May, 1959).

The authors have made a detailed study of the 2323 cm^{-1} vibration-rotation band of N_2O by using samples cooled to −80°C and by eliminating the masking effect of atmospheric CO_2 absorption. Values are given for the molecular constants of the band.

D.L.Greenaway

535.343 : 537.311.33

7964. OPTICAL PROPERTIES OF SEMICONDUCTORS UNDER HYDROSTATIC PRESSURE. III. GERMANIUM—SILICON ALLOYS.
W.Paul and D.M.Warschauer.
J. Phys. Chem. Solids, Vol. 6, No. 1, 6-15 (July, 1958).

For Pt II, see Abstr. 209 (1959). The optical absorption edge of a number of germanium—silicon alloys has been measured at room temperature as a function of hydrostatic pressure from 1 to 7000 kg/cm^2. The pressure variation of the energy corresponding to the edge $(dE/dP)_T$ varies continuously with composition from pure germanium to pure silicon. A break in this curve is found between 10 and 20% silicon, consistent with an interpretation in which the (100) conduction-band minimum becomes lower than the (111) minimum as silicon content is increased.

535.343

7965. ABSORPTION SPECTRUM OF LIQUID OXYGEN IN THE TEMPERATURE RANGE 77-153°K (12600-3300 A).
V.I.Dianov-Klokov.
Optika i Spektrosk., Vol. 4, No. 4, 448-54 (April, 1958). In Russian.
English summary: PB 141047T-9, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

The extinction coefficient ϵ_m was measured at the band maxima and integral absorption coefficients found for the 12600 and 10600 A bands. The change of ϵ_m/ρ with temperature, where ρ is the density of the liquid, is similar for the five Ellis—Kneser groups, $^3\Sigma - {}^1\Delta$, $^3\Sigma - {}^1\Sigma$, $2^3\Sigma - 2^1\Delta$, $2^3\Sigma - ({}^1\Delta + {}^1\Sigma)$, $2^3\Sigma - 2^1\Sigma$, and is also similar to the change of ρ with temperature. Results are given for determination of ϵ_m in the liquid diluted with N_2 at 78°K, whereby the oxygen spectrum is generally weakened. Temperature change affects various groups of bands differently in dilution. It is suggested that the absorption spectrum is due to the complex $(O_2)_2$ in liquid or compressed oxygen.

S.T.Henderson

535.343

7966. ABSORPTION SPECTRUM OF BISMUTH-DOPED SILICON.
H.J.Hrostowski and R.H.Kaiser.
J. Phys. Chem. Solids, Vol. 4, No. 4, 315-17 (1958).

The infrared absorption spectrum at 4.2°K indicates a more detailed donor-term scheme than has previously been observed for other Group V impurities. Positions of p-type levels relative to the conduction band are in excellent agreement with existing theory. A "forbidden" transition to the degenerate 2s levels is also observed. The optical ionization energy is 70.6×10^{-3} eV, in good agreement with the thermal value of 69×10^{-3} eV.

535.343 : 537.311.33

OPTICAL MAGNETO-ABSORPTION IN SEMICONDUCTORS. See Abstr. 6970

535.343 : 539.19

7967. MICROWAVE SPECTRUM AND MOLECULAR STRUCTURE OF VINYL FLUORIDE. H.W.Morgan and J.H.Goldstein.
J. chem. Phys., Vol. 30, No. 4, 1025-8 (April, 1959).

The J = 0→1 and J = 1→2 transitions were measured in the microwave spectra of the isotopic vinyl fluoride molecules $C^{12}H_2C^{12}HF$, $C^{13}H_2C^{12}HF$, and $C^{12}H_2C^{13}HF$. Parameters obtained from the spectra are b = 10636.83, 10295.26, and 10635.02 Mc/s, and c = 9118.18, 8859.05, and 9082.78 Mc/s, respectively. Moments were computed for 1134 assumed structures, and used to obtain derivatives of the moments with five structural parameters. Least squares determinations gave the following structure: $r_2(CC) = 1.337 \pm 0.002$ A, $r_4(CF) = 1.344 \pm 0.002$ A, $\angle CCF = 121.0 \pm 0.2^{\circ}$, $r_1(CH) = 1.075 \pm 0.005$ A, and $r_3(CH) = 1.080 \pm 0.005$ A. Assumed was $\angle CCH = 120^{\circ}$.

535.343 : 539.19

MICROWAVE SPECTRUM OF VINYL CYANIDE. See Abstr. See Abstr. 7471.

535.343.9 : 535.375.5

7968. HIGH RESOLUTION RAMAN SPECTROSCOPY OF GASES. XII. ROTATIONAL SPECTRA OF C_2H_4 AND C_2D_4 AND THE STRUCTURE OF THE ETHYLENE MOLECULE.
J.M.Dowling and B.P.Stoicheff.
Canad. J. Phys., Vol. 37, No. 6, 703-21 (June, 1959).

For Pt XI, see Abstr. 3877 (1958). The pure rotational Raman spectra of C_2H_4 and C_2D_4 were photographed in the second order of a 21 ft grating. The resolution achieved was such that several lines due to single transitions were observed (and identified) in the spectra of both molecules. An analysis of these lines based on the non-rigid asymmetric top yielded the following rotational constants for the ground states:

$$C_2H_4 : A_0 = 4.828 \pm 0.009,\ B_0 = 1.0012 \pm 0.0009,\ C_0 = 0.8282 \pm 0.0004\ \text{cm}^{-1};$$
$$C_2D_4 : A_0 = 2.432 \pm 0.008,\ B_0 = 0.7369 \pm 0.0012,\ C_0 = 0.5630 \pm 0.0006\ \text{cm}^{-1}.$$

The structural parameters obtained from these constants are $r_0(C{=}C) = 1.339 \pm 0.002$ A, $r_0(C{-}H) = 1.086 \pm 0.003$ A, and $\angle H{-}C{-}H = 117^{\circ}34' \pm 30'$. These values are in agreement with the recent preliminary results of the electron diffraction data. There is also agreement between the above values and those obtained from a recent study of the rotation-vibration spectra of C_2H_4 and C_2D_4, although the agreement between the ground state rotational constants is not as satisfactory.

535.345 : 539.216

7969. USE OF FIBER SPECIMENS FOR INFRARED ABSORPTION MEASUREMENTS. R.D.B.Fraser.
J. Opt. Soc. Amer., Vol. 48, No. 12, 1017-18 (Dec., 1958).

The correction δd to an observed optical density to give that which applies to a uniform specimen of rectangular section is a function of the observed value d and a curve relating δd and d is given. G.F.Lothian

535.345

7970. ULTRAVIOLET TRANSPARENT ALKALI METAL FILTERS. C.H.Shaw and W.T.Foreman.
J. Opt. Soc. Amer., Vol. 49, No. 7, 724-8 (July, 1959).

More or less uniform cells of ultraviolet transparent fused quartz about 1μ thick and over 2 in. dia. have been produced and filled with sodium—potassium alloy, which is liquid at room temperature. These filters, while opaque in the visible, are transparent in the ultraviolet, with a cutoff wavelength lying between that for pure sodium (2100 A) and pure potassium (3400 A) and determined by the alloy composition. A tentative formula for the calculation of the cutoff wavelength is proposed and tested. The optical constants for the alloy were determined and are compared with those of the pure metals and with Kronig's theory.

535.345.6 : 537.533

OPTICAL FILTER FOR THE COMPENSATION OF THE SPECTRAL EFFICIENCY DISTRIBUTION OF PHOTOCATHODES. See Abstr. 7066

535.345.6 : 522.6

SOME NEW BIREFRINGENT FILTERS FOR SOLAR RESEARCH. See Abstr. 7729

535.37

7971. LUMINESCENT "τ-METER" OF NEW TYPE. K.Pátek.
Czech. J. Phys., Vol. 7, No. 6, 744-7 (1957). In Russian.

Describes an instrument for recording the exponential course of the long decays or growths of luminescence, consisting of an oscillograph with a linear time base and a means for taking the logarithm of the measured signal. The anode characteristics of a photomultiplier are such that when operated at constant current the applied voltage is proportional to the log of the illumination. If the variation of the illumination with time is exponential then the variation of the applied voltage with time is linear and the relaxation time can be obtained directly from the gradient. W.Bardsley

535.37

7972. LUMINESCENCE OF SOLIDS PRODUCED BY SURFACE COMBINATION OF ATOMS.
K.M.Sancier, W.J.Fredericks and H.Wise.
J. chem Phys., Vol. 30, No. 5, 1355-6 (May, 1959).

Luminescence of activated CaO phosphors has been stimulated by the recombination on the phosphor surface of atoms of hydrogen, oxygen or nitrogen from a high-frequency electrodeless discharge. The intensity of the luminescence decreases with increase in temperature from 25° to 560°C, and also with time at temperatures up to 212°C. Some theoretical aspects of this heterogeneous chemiluminescence are discussed qualitatively. J.B.Birks

535.37

7973. BEHAVIOR OF SEVERAL PHOSPHORS UPON IRRADIATION IN THE VACUUM ULTRAVIOLET. R.L.Conklin.
J. Opt. Soc. Amer., Vol. 49, No. 7, 669-72 (July, 1959).

Several crystal phosphors have been irradiated by ultraviolet wavelengths from 500 A to 1700 A. The emission spectra of all were found to be independent of exciting wavelength. The quantum efficiencies of Zn_2SiO_4:Mn, $CaSiO_3$:Pb:Mn, and ZnO:[Zn], relative to sodium salicylate, increased with decreasing excitation wavelengths below 1000 A. It is suggested that this increase may be accounted for by internally emitted electrons. Several tungstate and titanate phosphors showed minima in their excitation spectra at about 1100 A, with increases for longer or shorter exciting wavelengths. Anomalous results are reported for ZnS:Ag, $BaSi_2O_5$:Pb, and $Mg_6As_2O_{11}$:Mn

535.37

7974. VERSATILE APPARATUS FOR AUTOMATIC RECORDING OF ABSOLUTE FLUORESCENT SPECTRA. F.R.Lipsett.
J. Opt. Soc. Amer., Vol. 49, No. 7, 673-9 (July, 1959).

An optical system is described in which ultraviolet light from a suitable source is dispersed by a grating monochromator and focused on a specimen. Fluorescent light from the specimen passes through a second grating monochromator and is detected by a photomultiplier tube. The specimen is placed in a stand which rests on a kinematic trolley, by means of which the specimen is brought into focus and which allows stands with reference markings, an MgO surface, or a cold cell to be used. The optical system is calibrated photometrically by means of a standardized tungsten-quartz lamp. The spectral sensitivity characteristics of the detecting photomultiplier, together with its associated monochromator and mirrors, are corrected by means of a cam driven in synchronism with the wavelength drive of the detecting monochromator. In order to cancel fluctuations in the exciting light source a fraction of the light emerging from the source monochromator is focused on to a second photomultiplier, whose output is used to operate a servo system. The recorded spectrum is thus a measure of the ratio of fluorescent to exciting light. The currents from the photomultipliers are amplified by d.c. amplifiers with silicon diode modulators, which are described.

535.371

7975. TEMPERATURE DEPENDENCE OF THE PHOTOLUMINESCENCE INTENSITY OF ZINC—CADMIUM SULPHIDE. I.Soudek.
Czech. J. Phys., Vol. 7, No. 1, 109 (1957). In Russian.

The photoluminescence intensity, studied in the range 10°-370°C, is found to vary non-monotonically with temperature, and to display hysteresis. Although the non-monotonic nature of the variation and the change in colour with temperature can be explained by the existence of two types of luminescence centre, this does not account for the hysteresis. The latter is explained by the occurrence of red centres at higher temperatures, and the increase in their concentration with temperature; since a definite time is required for formation and annihilation of these centres, their concentration at a given temperature is greater when the temperature is decreasing. Another possibility is that quenching of red centres occurs at a lower temperature than that for formation.
V.V.Zakharov

535.371

7976. ENERGY TRANSPORT MECHANISM IN CdS CRYSTALS.

I.Broser and R.Broser-Warminsky.
J. Phys. Chem. Solids, Vol. 6, No. 4, 386-400 (Sept., 1958).
In German.

In photoconducting phosphors the spreading of the energy of excitation from the point of absorption to unirradiated regions of the crystal plays an important part. It had been established previously for cadmium sulphide single crystals that besides the energy transfer over only short distances by means of charged particles, still another process must take place in which photoconduction is spread over relatively large distances. In the present work is is shown that all the results obtained heretofore can be explained if it is assumed that the process with a large diffusion length results from the scattering and reabsorption of the incident light or the luminescent radiation generated in the crystal. The repeatedly introduced hypothesis of energy conduction by excitons is not supported by a more precise analysis of the experimental results. The transfer of energy by means of charged particles may be investigated using high purity crystals which do not absorb their own luminescent radiation, i.e. in which the process of light scattering is nearly eliminated. From the non-linear voltage dependence of the photo-current of a crystal excited at one side only, it is concluded that holes are the determining factor for this energy conduction. The diffusion length is about 1 μ and has a positive temperature coefficient.

535.371 : 537.312.5

7977. ENERGY TRANSFER IN ZnS : Cu : In PHOSPHORS.

N.T.Melamed.
J. Phys. Chem. Solids, Vol. 9, No. 2, 149-52 (Feb., 1959).

Transport of energy between luminescence centres has been observed in ZnS : Cu : In phosphors at room temperature and at 77°K. The results support a photoconductive transfer mechanism. Energy transfer at low temperatures can be interpreted as resulting from a process in which a given wavelength is capable of putting an electron into an impurity level from the valence band, as well as exciting it from the same impurity level to the conduction band.

535.371

7978. THE TEMPERATURE-DEPENDENCE OF THE FLUORESCENCE OF PHOTOCONDUCTORS.

H.A.Klasens.
J. Phys. Chem. Solids, Vol. 9, No. 3-4, 185-97 (March, 1959).

A two-state model is considered, with one level near the conduction band and occupied by an electron in the dark and one state near the conduction band and not occupied in the dark. The effect of temperature in the stationary state is discussed. The lower level is assumed to be an activator level giving rise to a fluorescent transition, whereas the other level is attributed to a killer centre. The phosphor is excited with long wavelengths bringing electrons from the activator level to the conduction band. It is shown that the nature of the temperature-dependence curve can be strongly affected by the capture cross-sections for electrons and holes of the two centres. A plot of $\log(I_0/I - 1)$ v. T^{-1} will in general not produce straight lines as in the case of non-photoconducting phosphors, and no conclusions can be drawn from such a plot regarding the positions of the impurity levels. The best way to determine the position of the activator level is to excite the phosphor at high intensities. A plot of $\log\{(I_0/I)^{1/2} - -(I/I_0)^{1/2}\}$ v. T^{-1} will then have a slope corresponding to the thermal-energy difference between the activator level and the top of the highest occupied band.

535.371

7979. MICROSCOPE PHASE FLUOROMETER FOR DETERMINING THE FLUORESCENCE LIFETIMES OF FLUOROCHROMES.

B.D.Venetta.
Rev. sci. Instrum., Vol. 30, No. 6, 450-7 (June, 1959).

A microscope which can measure the mean fluorescence lifetimes of small fluorescent samples is described. Special emphasis is given to fluorochromes dissolved in biological solutions and bound to thin polymeric substances, such as the desoxyribonucleic acid complexes present in the nuclei of cells. Fundamentally, the method is similar to that described by physicists and physicochemists for solutions of fluorochrome only. A diffraction modulator is used to sinusoidally modulate the intensity of a high-pressure mercury-vapour lamp. The phase shift between the unabsorbed exciting light, passing through the microscopic sample, and the fluorescent light is related to the fluorescence lifetime by $\tan\Delta\phi = \omega\tau$. The phase shift $\Delta\phi$ is obtained differentially from the phase angles ϕ_1 and ϕ_2 of each microscopic light signal with respect to a third less noisy signal, the tracer signal. The principal effort has been directed toward studying the various sources of error in the fluorometer and variabilities in lifetime measurements. The data indicate that the mean fluorescence lifetime (2.7 msec) of proflavine, bound to nuclei of tumour cells and observed with a 130 × oil immersion lens, can be determined with a precision of 4×10^{-10} sec.

535.371

7980. THE DETERMINATION OF THE ABSORPTION COEFFICIENT OF LUMINESCENT MICROCRYSTALS.

G.Gergely.
Optica Acta, Vol. 3, No. 4, 184-8 (Dec., 1956).

The absorption and luminescence emission of single Zn-type microcrystals was investigated. A photoelectric microscope photometer was built, consisting of a Zeiss microscope and a 931 A multiplier phototube. Evaluating the results of absorption measurements, neither a plane-parallel, nor a spherical crystal model furnished reliable results for the absorption coefficient. The application of an empirical model, based on the non-absorbed radiation (5770 A) made possible the determination of the ultraviolet absorption coefficient by comparing the transmission of single microcrystals for different wavelengths. The method was experimentally checked on $K_2Cr_2O_7$ crystals. The ultraviolet absorption coefficient of luminescent microcrystals may also be determined from the dependence of the light emission on the particle size.

535.371

7981. PHOSPHORESCENCE OF SODIUM ACETATE.

K.Osada.
J. chem. Phys., Vol. 30, No. 5, 1363-4 (May, 1959).

The decay curves of the blue and green phosphorescence, excited by 254 mμ radiation, were measured, as well as the temperature dependence of the lifetimes. The distribution of the phosphorescence spectrum does not change in the region investigated (room temperature to -150°C), but the intensity of the spectrum is quenched by adsorbed O_2. The phosphorescence is attributed to either Pb or Cu impurities which were present to $\sim 5 \times 10^{-5}$% by weight.

F.Ansbacher

535.371.07 : 537.531

7982. DETERMINATION OF THE CONDITIONS OF MAXIMUM EFFICACY OF FLUORESCENT SCREENS BY MEANS OF X-RAY BEAMS PREVIOUSLY FILTERED THROUGH PARAFFIN WAX.

E.Luca, H.Chelaru, G.Chern, G.Mastacan, I.Mărgărint and G.Trifan.
Bul. Inst. Politeh. Iasi, Vol. 3 (VII), No. 3-4, 77-84 (1957).
In Roumanian.

Paraffin wax filters of different thickness were used to simulate conditions encountered in medical work when the screen is hit only by X-ray beams rich in diffuse X-rays by reason of having traversed a human body. The efficacy curve of the fluorescent screen shows one maximum for a certain voltage, just as for Al filters studied in a previous paper (Luca, Iliescu and Reus, Bul. Inst. Politeh. Iasi, Vol. 1 (V), No. 1-2, 32, 1955). As the filter thickness increases the maximum shifts towards the longer waves, while its height decreases.

F.Lachman

535.376

7983. THE TEMPERATURE DEPENDENCE OF ELECTROLUMINESCENCE AND THERMOSTIMULATED ELECTROLUMINESCENCE IN ZnS : Cu.

K.Pátek.
Czech. J. Phys., Vol. 7, No. 5, 584-91 (1957).

The positions of the maxima of the glow curves for non-electroluminescent ZnS : Cu were unaltered by an a.c. field of $\sim 10^4$ V/cm applied across the phosphor layer. Electroluminescent phosphors gave the same result when the electroluminescence was subtracted from the total light curves, and the use of d.c. to avoid electroluminescence also confirmed this. Thornton's theory (Abstr. 3643 of 1956) requires the donor depths, and therefore the glow maxima positions, to alter with the field, but it is considered that much higher fields would be required to make the effect evident. The temperature dependence of electroluminescence agrees with Thornton's theory. If a linear relation exists between log I and 1/T, then the slope decreases with increased field; if the curve of log I versus T shows a maximum, this shifts to lower temperature with increased field.

S.T.Henderson

535.377

7984. THE LUMINESCENCE OF SODIUM CHLORIDE ACTIVATED BY CALCIUM AND STRONTIUM AND EXCITED BY SOFT X-RAYS.

J.Dolejší.
Czech. J. Phys., Vol. 6, No. 6, 629-31 (Dec., 1956). In German.

Synthetic NaCl crystals coloured by X-rays were examined for thermoluminescence. NaCl gave an emission peak at 4660 A, and glow peaks at 360° and 520° K. NaCl : Ca had peaks at 3380, 4350 and 5600 A, with the main glow at 450° K and a minor effect at 470° K. NaCl : Sr had peaks at 3760 and 4950 A, and the glow at 480° K. After a second irradiation NaCl behaved as before, but the glow maxima changed to 430° and 470° K (the second greater) for NaCl : Ca, and to 470° K for NaCl : Sr. S.T.Henderson

535.377 : 539.2

SYNTHESIS OF COLOUR CENTRES IN SILICA AND THEIR THERMOLUMINESCENCE. See Abstr. 7519

535.39

7985. SOME OPTICAL PROPERTIES OF SYMMETRICALLY STRATIFIED LAYERS. F.Abelès.

Optica Acta, Vol. 4, No. 1, 42-3 (March, 1957). In French.

The first case treated is that of absorbing strata between non-absorbing boundaries. Relationships between reflectivity, transmission and phase change are given. Polarization effects are treated. The limit case when the strata reduce to a single absorbing film is examined. Formulae are also reported for the non-absorbing case. S.Tolansky

535.393 : 539.234

7986. OPTICAL TRANSMISSION OF EVAPORATED In, Sn, AND Bi FILMS IN THE VACUUM ULTRAVIOLET.

W.C.Walker, O.P.Rustgi and G.L.Weissler.

J. Opt. Soc. Amer., Vol. 48, No. 12, 1017 (Dec., 1958).

Pines' theory predicts that electromagnetic waves are transmitted through metals for frequencies greater than a certain plasma frequency. Measurements on unbacked evaporated films indicated that the onset of transmission occurs at 11.2 eV for In (as compared with the plasma frequency of 12.5 eV assuming 3 free electrons/atom), at 13.6 eV for Sn (plasma frequency of 14 eV for 4 electrons/atom) and at 18 eV for Bi (plasma frequency of 14 eV for 5 electrons/atom). The transmission regions are terminated on the high frequency side by sharp absorption edges, attributed to various interband transitions. B.T.M.Willis

535.39

7987. REFLECTING POWER OF BULK SILICON AND GERMANIUM BETWEEN 1000 AND 3000 Å.

S.Robin-Kandare and B.Vodar.

C.R. Acad. Sci. (Paris), Vol. 248, No. 13, 1965-7 (April 1, 1959). In French.

The reflecting power of single crystals varies according to the surface treatment. The reflecting power of silicon in the far ultraviolet is one of the highest known. B.T.M.Willis

535.39 : 778.6

7988. REFLECTIVITY CURVES BY MULTIPLE LAYERS OF ALTERNATING REFRACTIVE INDICES ON IMAGE BASIS AND LIPPMANN PHOTOGRAPHY. M.Iwata, S.Katsube and T.Fukuda.

Sci. of Light (Tokyo), Vol. 7, No. 2, 33-41 (Aug., 1958).

The reflectance of a multilayer of structure $\frac{1}{2}LHLH-HLH\frac{1}{2}L$, where L and H are $\lambda/4$ films of refractive indices 1.53 and 1.61 respectively, is shown to approximate to the measured reflectance of a Lippmann photograph of a spectrum line. W.T.Welford

535.41

7989. ON THE DERIVATION OF EQUATIONS FOR THE REFLECTION AND REFRACTION OF LIGHT FROM A THIN FILM. A.Vašíček.

Czech. J. Phys., Vol. 7, No. 3, 369-70 (1957).

A derivation in terms of the Fresnel reflection and transmission coefficients at each interface. W.T.Welford

535.41

7990. ON THE FORMULAE FOR THE LIGHT REFLECTED AND TRANSMITTED BY A THIN METAL FILM. A.Vašíček.

Czech. J. Phys., Vol. 7, No. 4, 417-26 (1957).

An alternative derivation is presented in which the formulae for a transparent film are generalized to take account of the fact that the Fresnel reflection and transmission coefficients and the film optical thickness are complex. W.T.Welford

535.41

7991. THE USE OF THE PRINCIPLE OF REVERSIBILITY IN DERIVING KNOWN RELATIONS FOR A SYSTEM OF OPTICAL THIN FILMS. Z.Knittl.

Czech. J. Phys., Vol. 7, No. 4, 427-31 (1957).

The principle is applied to transparent multilayers to prove that the reflection and transmission factors are the same from each side and to obtain the recurrence relation for the reflection coefficient. W.T.Welford

535.41

7992. AN UNCERTAINTY RELATION IN INTERFEROMETRY. B.S.Thornton.

Optica Acta, Vol. 4, No. 1, 41-2 (March, 1957).

An uncertainty principle is applied to the information which can be extracted from multiple-beam interference fringes. It is shown that with green light and low order interferometry a volume element approximating to 3.5×10^{-15} cm^3 should be resolvable. This is in satisfactory agreement with a value of 5×10^{-15} cm^3 found experimentally by Tolansky and Emara. S.Tolansky

535.411

7993. A THEORY OF AN IMPROVED INTERFERENCE LIGHT FILTER WITH TOTAL REFLECTION. P.G.Kard.

Optika i Spektrosk., Vol. 4, No. 5, 643-50 (1958). In Russian. English summary : PB 141047T-2, obtainable from Office of Technical Services, U.S.Dept. of Commerce, Washington, D.C., U.S.A.

Three-layer interference filters described in the published literature suffer from a serious disadvantage because the position of their transmission band depends on polarization of the incident light. If the incident light is unpolarized then the filter has, instead of one transmission band, two such bands which differ in their polarization. This effect is called the doublet structure of the transmission band. A light-filter whose theory is given in the presen paper consists of two identical glass prisms separated by an odd number (greater than three) of layers. The odd layers all have the same thickness h_1 and the same low refractive index n_1, such that the condition for total reflection is satisfied for these layers. Layers with the even number have the same thickness h and the sam refractive index n, which is taken to be equal to the refractive index of the prisms. It is shown that a proper selection of the layer thicknesses, refractive indices and the angle of incidence causes the two transmission bands, for the two mutually perpendicular polarizations, to coincide, provided that the number of layers is not less than five. The paper is purely theoretical.

535.412

7994. MAXIMUM CONTRAST CONDITION BY MULTIPLE-BEAM INTERFERENCE IN REFLECTION. F.Kroupa.

Czech. J. Phys., Vol. 7, No. 5, 631-2 (1957).

The influence of absorption and reflection on the contrast in reflection multiple-beam interference fringes is discussed briefly. Modified formulae for the fringe shape are given. S.Tolansky

535.412

7995. POSITION AND VISIBILITY OF WEDGE INTERFERENCE IN INSTRUMENTAL OBSERVATIONS (CONTRIBUTION TO THE COHERENCE THEORY FOR THE CASE OF UNSYMMETRICAL INTERFERENCE). R.Landwehr.

Optica Acta, Vol. 6, No. 1, 52-76 (Jan., 1959). In German.

In connection with recent possibilities of improving the sensitivity of interference methods, an old and somewhat forgotten work of Ignatowski (1935) is rediscussed with reference to recent work on coherence theory. New curves are calculated and applied to the cas of unsymmetric interference, both phase alteration and visibility being discussed. The discussion is extended to include big phase differences. The treatment is concerned with the character of the source, includes a historical survey and is applied to interferometry for the measurement of end standards. S.Tolansky

535.41

7996. ACHROMATIC FRINGES FORMED IN A TRIANGULAR PATH INTERFEROMETER. P.Hariharan and R.G.Singh.

J. Opt. Soc. Amer., Vol. 49, No. 7, 732-3 (July, 1959).

A Lodge interferometer in normal adjustment produces straigh white light fringes at infinity. These can be achromatized by placin a tilted plane parallel plate in the triangle; alternatively the fringes can be made more chromatic by tilting the plate in the opposite sen W.T.Welfor

535.41

7997. A HAIDINGER INTERFEROMETER WITH LINEAR SCALE FOR THICKNESS SEPARATION OF THE PLANE PARALLEL PLATES. R.Riekher.

Optik, Vol. 15, No. 12, 713-23 (Dec., 1958). In German.

An instrument for measuring separation between plane parallel plates is described, using Haidinger's rings. By employing a parabolic mechanical linkage the instrument works on a linear scale. Use of the system is described. Errors are discussed.

S.Tolansky

535.417

7998. THE THIRD ORDER ABERRATIONS IN THE INTERFEROMETRIC MEASUREMENT OF CONCENTRATION GRADIENTS.

H.Svensson.

Optical Acta, Vol. 3, No. 4, 164-83 (Dec., 1956).

The optical path difference between two coherent rays in the interferometric recording of a diffusion boundary is computed to the accuracy represented by terms of the third order in the entrance angle and the refractive index difference across the boundary. It is found that even third-order terms acquire a minimum value for that defocusing of the middle of the cell which in the second order theory was found to eliminate the Wiener skewness aberration. The third order aberrations are found to be highly dependent on the entrance angle, and there is a certain entrance angle that is more favourable than any other angle. The third-order aberrations are shown to decrease rapidly with time, and it is possible to define a critical initial time period of diffusion, after which the aberrations can no longer be observed. This critical time period is shown to be at a minimum for the optimum entrance angle. Exact equations for the optimum entrance angle and for the critical time period are given in terms of apparatus constants and the total number of fringes in the interferogram. The blurring of fringes due to a vertically extended light source in conjunction with a defocused cell is put in relation to the critical time period. It is possible to arrange an automatic guard against the evaluation of interferograms not yet free from aberrations by certain adjustments causing the blurring and the aberration to fade out to insignificance at the same time. The effect of uncollimated light is analysed, and exact conditions for the divergence or convergence of the light are presented.

535.417 : 531.715

7999. MEASUREMENT OF THE THICKNESS OF VERY FINE TRANSPARENT FILMS BY THE INTERFERENCE METHOD.

B.Gadžuk.

Slaboproudý Obzor, Vol. 20, No. 2, 85-7 (1959). In Czech.

A beam of white light is directed, at an angle of less than 90°, on to the film, and the interference fringes observed, the number of the fringes being directly proportional to the thickness of the film. The method is suitable for the measurement of the glass foils in image orthicons having a thickness of 1-10μ. It can also be employed for the measurement of films up to 100μ.

R.S.Sidorowicz

535.42 : 517.6

8000. RELATION BETWEEN THE INVERSION FORMULAS FOR THE SOMMERFELD INTEGRAL AND THE FORMULAS OF KONTOROVICH–LEBEDEV.

G.D.Malyuzhinets.

Dokl. Akad. Nauk SSSR, Vol. 119, No. 1, 49-51 (1958). In Russian. English translation in: Soviet Physics — "Doklady" (New York), Vol. 3, No. 2, 266-8 (March-April, 1958).

A formal derivation showing that the transform pair of Sommerfeld integral and its inverse can be reduced to the transform pair of Kontorovich–Lebedev, provided that: $F(0) = f(i\infty) = 0$, where $F(r)$ is the Sommerfeld integral for constant angle φ in the cylindrical system used, and where $f(\alpha)$ is the transform of F.

J.K.Skwirzynski

535.42

8001. TWO PROBLEMS OF OPTICAL DIFFRACTION AT LARGE APERTURE.

R.Burtin.

Optica Acta, Vol. 3, No. 3, 104-9 (1956). In French.

In the first a point source at infinity forms an image at the focus of a wide aperture objective and the distribution of electric field strength in the focal plane is calculated. In a numerical example the semi-angular aperture was 45°. In the second problem, the source is on the wide aperture side and the image is formed at a great distance; no numerical results are given for this case.

W.T.Welford

535.42

8002. MACHINE FOR CALCULATING CONVOLUTIONS FOR CORRECTING CERTAIN ERRORS DUE TO DIFFRACTION (UNIDIMENSIONAL PROBLEMS).

P.Dumontet.

Optica Acta, Vol. 3, No. 3, 145-6 (1956). In French.

An optical analogue computor for imposing a chosen spatial frequency distortion on a unidimensional optical image.

W.T.Welford

535.42 : 538.566

THEORY OF SCALAR DIFFRACTION AND ITS APPLICATION TO THE PROLATE SPHEROID. See Abstr. 7215

535.421

8003. AN ASPHERICAL DIFFRACTION GRATING WITH ONE PLANE OF SYMMETRY. II. PERMISSIBLE VALUES OF ABERRATIONS. THE RANGE OF APPLICATION AND EFFICIENCY OF AN ASPHERICAL GRATING.

Yu.P.Shchepetkin.

Optika i Spektrosk., Vol. 4, No. 4, 513-20 (April, 1958). In Russian. English Summary : PB141047T-9, obtainable from Office of Technical Services, U.S.Dept. of Commerce, Washington, D.C., U.S.A.

Continues the discussion of the author (ibid, Vol. 4, 383, 1958) on the aberrations of an aspherical grating. It is found that the best results are obtained by placing the grating on the circumference of the Rowland's circle and correcting for aberrations at points lying on this circle. On departure from angles corresponding to the position of aberration-free points, the aberrations increase slowly. In this way, a range of angles is obtained in which practically aberration-free slit images are produced. These slit images are sharper at larger angles of incidence and diffraction for which a theoretical correction of aberrations was made. The greatest efficiency of the grating is expected to be in the ultraviolet region, at glancing incidence and using narrow and short slits. Under these conditions, the resolving power of the apparatus is increased. The increase of the grating aperture compared with the spherical grating and correction for astigmatism makes it possible to increase the spectrum intensity by a factor of the order of 10-100.

535.43 : 537.226.1

8004. LIGHT SCATTERING NEAR SECOND-ORDER PHASE-TRANSITION AND CURIE POINTS.

V.L.Ginzburg and A.P.Levanyuk.

J. Phys. Chem. Solids, Vol. 6, No. 1, 51-8 (July, 1958).

Light scattering near second-order phase-transition and critical Curie points is considered. The transition is assumed to be specified by one parameter η, the fluctuations of which are reflected in refractive index fluctuations at which light is scattered. Near the Curie point the scattering is of the "critical opalescence" type. The scattering near the $\alpha \rightleftharpoons \beta$ transition in quartz is most probably of this type; particular attention is devoted to this case.

535.434

8005. A GENERALIZATION OF RAYLEIGH'S THEORY OF DEPOLARIZATION OF LIGHT SCATTERED BY VERY SMALL ANISOTROPIC PARTICLES.

J.Moser.

Annu. Fac. Phil. Skopje, Sect. Sci. nat., Vol. 7, 85-110 (1954). In Serbo-Croatian, with summary (3 pp.) in German.

Rayleigh's theory refers to the particular case when scattered light is observed normally to the direction of the primary light. Formulae are derived and discussed for the depolarization of scattered light irrespective of the direction of observation. Secondary scattering is disregarded.

F.Lachman

535.434

8006. AN APPROXIMATION METHOD TO THE MIE THEORY FOR COLLOIDAL SPHERES.

R.B.Penndorf.

J. phys. Chem., Vol. 62, No. 12, 1537-42 (Dec., 1958).

An approximation method is outlined for computing the total Mie scattering coefficient K in dispersed systems of light scattering spheres. The method is valid for any size parameter, from small to very large spheres and any arbitrary real refractive index $n \leq 2$. Analytical expressions are developed for the phase and the amplitude of K at the maxima and minima. The constants in these analytical expressions are determined from existing data computed by the exact Mie theory. Finally, K values for any arbitrary size are determined by a graphical interpolation process. This approximation method leads to an accuracy of ±2 to 3% for K as compared with results obtained by the Mie theory. Results are shown for selected refractive indices.

535.51

8007. NEW ANALYSIS OF THE POLARIZATION OF RADIATION AND THE FARADAY EFFECT IN TERMS OF COMPLEX VECTORS.

K.C.Westfold.

J. Opt. Soc. Amer., Vol. 49, No. 7, 717-23 (July, 1959).

The properties of the polarization ellipse are deduced in terms of the ratio of the Cartesian components of the complex electric vector of a beam of radiation by utilizing the Argand representation of a real two-dimensional vector as a complex number. The two components of a beam that are accepted and rejected by a polarizer or a radio aerial are considered as orthogonal components in the directions of two complex orthonormal vectors. The intensities of the corresponding components of a polarized beam are derived and represented on the Poincaré sphere. The methods are then applied to the important radio case of the Faraday effect in a uniform magneto-ionic medium. Finally, the measurable quantities characterizing a beam of partially polarized radiation are obtained from a diagonalization of the complex polarization tensor that specifies the beam.

535.515

8008. BIREFRINGENCE OF QUARTZ AND CALCITE.

R.N.Smartt and W.H.Steel.

J. Opt. Soc. Amer., Vol. 49, No. 7, 710-12 (July, 1959).

The measured birefringences of quartz and calcite plates are given at several visible wavelengths for temperatures of 20° and 40°C.

535.555 : 539.319

8009. AN OPTICAL METHOD FOR INVESTIGATING THE AVERAGED STRAINED STATES OF FINE GRAINED POLYCRYSTALS. IV. THE ACTION OF A CONCENTRATED FORCE ON ANISOTROPIC (TEXTURED) POLYCRYSTALLINE PLATES.

R.A.Zhitnikov.

Zh. tekh. Fiz., Vol. 28, No. 9, 2004-10 (1958). In Russian.

For Pt I-III see Abstr. 5092 (1957). The strained state, arising under the action of a concentrated force in a polycrystalline plate of silver chloride, was studied by an optical method (by photographing the interference pattern produced when the birefringent plate was between crossed polaroids). The plates were prepared by pressing and rolling and the force was applied in different directions relative to the directions of pressing or rolling. Certain peculiarities of the piezo-optical behaviour of such polycrystalline plates under concentrated forces were elucidated. A.L.Mackay

535.555 : 539.319

8010. AN OPTICAL METHOD FOR INVESTIGATING THE AVERAGED STRAINED STATES OF FINE-GRAINED POLYCRYSTALS. V. STRAINS IN THE FREE OUTLINES OF ANISOTROPIC (TEXTURED) POLYCRYSTALLINE PLATES.

R.A.Zhitnikov.

Zh. tekh. Fiz., Vol. 28, No. 9, 2011-18 (1958). In Russian.

An optical method was used to investigate the distribution of strains in the unsupported edges of plates of polycrystalline silver chloride having holes and notches. The growth of these strains on extension of the plates was examined. The diametral compression of plane rings prepared from these polycrystalline plates was also studied. The plates were 2 mm thick and photographs of the strain birefringence pattern were taken with both circularly and linearly polarized light. A.L.Mackay

535.555 : 539.319

8011. COMPARISON WITH THEORY OF THE EXPERIMENTAL RESULTS GIVEN BY AN OPTICAL METHOD OF INVESTIGATING STRAINED STATES IN POLYCRYSTALS.

R.A.Zhitnikov and A.V.Stepanov.

Zh. tekh. Fiz., Vol. 28, No. 10, 2228-36 (1958). In Russian.

By the methods of the theory of the elasticity of anisotropic bodies the strain distribution round the outline of an opening in a polycrystalline plate of silver chloride under tension was calculated. The silver chloride plate was prepared by pressing or rolling. The calculations were compared with the measurements from strain birefringence made in previous papers (see two preceding abstracts) and there is no great conflict. Most of the deviations between observed and calculated strains are explicable as inaccuracies in the experimental observations but certain differences require further experimental investigation. A.L.Mackay

535.555 : 539.319

8012. INVESTIGATION OF LINEARLY STRAINED STATES IN POLYCRYSTALLINE SILVER CHLORIDE BY AN OPTICAL METHOD.

R.A.Zhitnikov and A.V.Stepanov.

Zh. tekh. Fiz., Vol. 28, No. 10, 2237-47 (1958). In Russian.

The characteristics of the piezo-optical behaviour of fine-grain quasi-isotropic polycrystalline silver chloride under uniform tension and elasto-plastic pure bending were studied. It was shown that if such a material underwent a small plastic deformation not changing its structure, then the average strains in it could be studied by an optical method just as they can in the case of elastic deformation. AgCl was found to be an especially suitable material for studying the residual strains after plastic deformation. Investigation of the bending of polycrystalline plates of AgCl showed that the optical method could be used for measuring strains after both plastic and elastic deformations. Pure bending gives a purely linearly strained state where the strains can be predicted for isotropic or anisotropic plates for elastic and for elasto-plastic deformations. This does not require exact knowledge of the properties of the material if quasi-isotropic. The quantitative agreement between calculated and experimental strains confirms that this optical method is a valuable one for studying strain distributions as many of the properties of polycrystalline silver chloride are similar to those of metals. A.L.Mackay

535.557

8013. BIREFRINGENCE DUE TO RESIDUAL STRESS IN SILICON.

J.Hornstra and P.Penning.

Philips Res. Rep., Vol. 14, No. 3, 237-49 (June, 1959).

Rapid cooling of large silicon crystals gives rise to plastic deformation, as can be deduced from the increase of the etch-pit density. Additional information is obtained from a study of the residual stress by observation of the birefringence with infrared light. When slices are cut from the quenched cylindrical crystal the stresses change. The calculated stresses are corrected for this effect. Tensile stress is measured by compensation with external pressure. Also the optical phase difference is determined and, by comparison of the two, the stress-optical constant. A smaller value than Giardini's was found; the difference, however, need not be significant. The present experiments strongly suggest that a very large part of the thermal stress is released by plastic deformation, when the initial temperature is above 1300°C. Residual stresses are also found in bars that have been bent at 750°C. From the stress pattern the stress distribution during plastic flow can be derived. This gives directly the relation between flow rate and stress. In some cases the relation $\dot{\epsilon} \propto \sinh(\sigma/\sigma_0)$, introduced by Van Bueren, was found; but often the stress pattern was more complicated due to the beginning of work hardening.

535.7

PHYSIOLOGICAL OPTICS. VISION. See also the Section entitled "BIOPHYSICS. PHYSIOLOGICAL PHYSICS".

535.81

8014. A NEW PRINCIPLE FOR THE DETERMINATION OF THE POWER OF LENSES. G.Ricci.

Atti Fond. Ronchi, Vol. 14, No. 2, 113-20 (March-April, 1959). In Italian.

A simple machine for the determination of the power of a lens is described. A scale is observed through the lens, which is held against a circular diaphragm about 15 cm from the eye. The length of the scale seen imaged across the diaphragm is a measure of the power of the lens, while the apparent movement of the axial point of the scale is a measure of the prism. R.W.Fish

535.822.1 : 539.1.07

A MICROSCOPE FOR THE SCANNING OF NUCLEAR RESEARCH EMULSIONS. See Abstr. 7229

535.822.9

8015. A REMOTE CONTROLLED AUTOMATIC MICROSCOPE.

M.Locquin.

C.R. Acad. Sci. (Paris), Vol. 248, No. 16, 2312-14 (April 20, 1959). In French.

The microscope is hydraulically controlled for focusing and for movements in the object plane, all motion being remotely controlled by the operator. The microscope can be used for visual observation or for photographic and photoelectric recording. The combination of movement and photoelectric receiver can be used to produce a television type of image. R.W.Fish

535.822.9

8016. FLYING-SPOT MICROSCOPE ADAPTED FOR QUANTITATIVE MEASUREMENTS. H.C.Box and H.G.Freund.

Rev. sci. Instrum., Vol. 30, No. 1, 28-30 (Jan., 1959).

Certain quantitative cytological measurements can be made by the addition of relatively simple components to a flying-spot microscope. The flying-spot system avoids "distributional errors" inherent in conventional microphotometry measurements. The microscope has been used to measure the desoxypentose nucleic acid in whole nuclei.

535.823.4

8017. A TILTING OBJECT STAGE FOR A MICROSCOPE. N.V.Gliki.
Kristallografiya, Vol. 3, No. 2, 243-5 (1958). In Russian.
English summary: PB 141065T-4, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

A universal stage, rather like the Fedorov stage but with glass hemispheres, is described. It can be used for the examination of specimens in incident or transmitted light when fitted to a petrographic microscope.

535.831.3 : 612.843

8018. STUDIES OF THE LAWS OF VISION IN TELESCOPES. H.Köhler and R.Leinhos.
Optica Acta, Vol. 4, No. 3, 88-101 (Sept., 1957). In German.

Landolt rings were used as recognition-objects and viewed through a binocular telescope at various intensity levels and contrasts. The effects on recognition (acuity) of the magnification and objective diameter are reported. For a given instrument, the acuity increased with magnification above 10^{-2} asb. and decreased with magnification below 10^{-3} asb. The acuity was found to be proportional to ΓP^{x} where Γ was the magnification, P the diameter of the exit pupil and x was a constant decreasing through unity to zero as the illumination increased. E.A.Mussett

535.834.4

8019. STRAY LIGHT IN OPTICAL IMAGES IN PRISM BINOCULARS. K.F.Leisinger.
Optik, Vol. 16, No. 2, 113-27 (Feb., 1959). In German.

A method of measuring stray light in binoculars is described in detail. It is particularly well suited to use in production testing. The measured values will depend upon the field of view and the diameter of the pupil. Curves illustrating this relationship in typical cases are given. R.W.Fish

535.89

8020. SUBMICROSECOND HIGH-INTENSITY LIGHT SOURCE. C.H Bagley.
Rev. sci. Instrum., Vol. 30, No. 2, 103-4 (Feb., 1959).

A short duration (1 or 2 × 10^{-8} sec) high-intensity explosive light source, that may be used in the laboratory, has been proved experimentally. The charge, weighing 4.8 g, yields a luminosity estimated in the neighbourhood of 8 × 10^{7} lumens. Pictures of high-speed shocks in air, transparent solids, and metal jets were taken using this lighting system.

535.89

8021. MILLIMICROSECOND LIGHT SOURCE. A.Whetstone.
Rev. sci. Instrum., Vol. 30, No. 6, 447-50 (June, 1959).

A fast light pulse can be produced by pulsing reverse current through a suitable silicon p—n junction. The light covers a range of photon energies from 1 to 3 eV. The immediate application is the testing of photomultiplier tubes, and, since any number of the junctions can be pulsed simultaneously, a method is available for lining up experiments in which large numbers of scintillators and coincidence circuits are used.

HEAT

536.2 : 537.311

8022. CONDITIONS FOR THE [VALIDITY OF THE] ELECTRIC MODELLING OF A TEMPERATURE FIELD WITH INTERNAL SOURCES OF HEAT. V.P.Mashovets and M.A.Korobov.
Zh. tekh. Fiz., Vol. 28, No. 10, 2124-9 (1958). In Russian.

The analogy between the inhomogeneous Laplace equations (Poisson equations) for electrical and thermal conduction is elaborated in some detail; also the analogy of the thermal and electrical boundary conditions is considered. Formulae are obtained for designing model experiments; practical performance of such experiments is not discussed. R.Eisenschitz

536.2 : 539.17

COOLING EFFICIENCY OF REACTOR COOLING CHANNELS. See Abstr. 7372-4

536.2.01 : 537.311.33

THERMAL CONDUCTIVITY IN SEMICONDUCTORS. See Abstr. 6930.

536.2 : 539.17

HEAT LOAD IN REACTORS. See Abstr. 7387

536.2.08

8023. REMARKS ON THE MEASUREMENTS OF THERMAL CONDUCTIVITY. J.Tavernier.
C.R. Acad. Sci. (Paris), Vol. 248, No. 8, 1135-8 (Feb. 23, 1959). In French.

A mathematical treatment of both steady and sinusoidal variable state, propagation of heat in a two-dimensional solid medium. The influence of the lateral loss of heat on the form of the isothermal surfaces is specially considered. S.Weintroub

536.21 : 548 : 539.2

8024. THERMAL RESISTANCE DUE TO ISOTOPES AT HIGH TEMPERATURES. V.Ambegaokar.
Phys. Rev., Vol. 114, No. 2, 488-9 (April 15, 1959).

In pure dielectric crystals, the isotopic variations of atomic mass contribute a temperature-independent thermal resistance at high temperatures. This resistance has been calculated using a Debye model of the vibrational spectrum. Umklapp processes are treated as the dominant scattering mechanism. The distribution of the heat current over the vibrational modes is known for low frequencies. This distribution is considered to apply over the whole frequency spectrum. The calculated result is compared with the experiments of Geballe and Hull on isotopically pure germanium. A satisfactory agreement with experiment is obtained.

536.212.2 : 537.312.62

8025. THE PHONON THERMAL CONDUCTIVITY OF SUPERCONDUCTORS. B.T.Geilikman and V.Z.Kresin.
Dokl. Akad. Nauk SSSR, Vol. 123, No. 2, 259-61 (1958). In Russian.

The lattice conductivity caused by electron—phonon interaction is considered. This is important at $T \geq (0.3\text{-}0.5)\ T_c$. The change in the phonon distribution function is found by solving the kinetic equation. The lattice heat current is expressed as an integral which reduces to the normal conductivity formula above the transition temperature. An approximate solution of the integrals for the superconducting state is given and this is in agreement with the experimental data. M.G.Priestley

536.23 : 537.56

THERMAL CONDUCTIVITY OF Xe HIGH-PRESSURE PLASMA. See Abstr. 7106

536.24

8026. THE TRANSPORT OF HEAT BETWEEN DISSIMILAR SOLIDS AT LOW TEMPERATURES. W.A.Little.
Canad. J. Phys., Vol. 37, No. 3, 334-49 (March, 1959).

The resistance offered to the flow of heat by the mismatch of the elastic constants at the interface between two materials has been calculated. It is shown that for a perfectly joined interface the heat flow is proportional to the difference of the fourth powers of the temperature on each side of the interface. Deviations from this temperature dependence are to be expected for rough surfaces and for surfaces pressed into contact with one another. The calculated contact resistance between some common solids is given, and graphs are presented from which the heat flow between any two materials may be computed. It is shown too that the spin—phonon, phonon—electron, and phonon—phonon relaxation processes give rise to additional resistive processes in some solids, some of which restrict the heat flow at the surface. The theoretical results compare well with the available experimental data. However, the problem of the contact resistance between helium and metals is still unresolved. A tentative explanation of this is presented which predicts that there should be an appreciable difference between the contact resistance of a metal in the normal and in the superconducting state.

536.241

8027. THE TEMPERATURE FIELD ESTABLISHED IN AN INFINITE PLANE FILM (CONSISTING) OF TWO LAYERS WITH A NORMAL TEMPERATURE DISTRIBUTION AT THE BOUNDARY WALLS. J.Klátil.
Czech. J. Phys., Vol. 6, No. 6, 551-7 (Dec., 1956). In Russian.

Formulae are derived for the temperature established at any point in a 2-layer plane film assuming a normal, time-independent, temperature distribution at both lateral walls, when a thermal change occurs in the plane of contact of the two layers. C.R.S.Manders

536.252

8028. ONSET OF CONVECTION IN LIQUIDS SUBJECTED TO TRANSIENT HEATING FROM BELOW. R.K.Soberman.

Phys. of Fluids, Vol. 2, No. 2, 131-8 (March-April, 1959).

Experimental studies were made of the onset of natural convection in liquids subjected to heating from below while insulated above. The temperature gradient necessary for convection to start was measured with a thermopile immersed in the liquid. When the liquids were not rotating, it was found that the temperature difference between the top and bottom surfaces required to initiate convection can be related with the heat input by the formula $Ra = 90.7\ (Ra\ Nu)^{0.304}$, $Ra > 1700$, where Ra is the Rayleigh number, and Nu is the Nusselt number, both specially defined for the transient case. Mercury and silicone oil were used in the experiments without rotation. It was found in experiments with mercury, that in the range of Taylor numbers covered, the presence of spin increased the temperature difference required to initiate convection. The Rayleigh number necessary for the onset of fluid motion in spinning mercury is plotted as a function of the Taylor number for several values of the heat flux.

536.252

8029. FREE HEAT CONVECTION OF MERCURY IN CLOSED CIRCULAR TUBES. A.G.Smirnov.

Zh. tekh. Fiz., Vol. 27, No. 10, 2373-80 (Oct., 1957). In Russian. English translation in: Soviet Physics–Technical Physics (New York), Vol. 2, No. 10, 2209-15 (Oct., 1957).

The convection was studied experimentally for steady state conditions in tubes inclined at 0°-30° to the vertical and heated electrically at their lower ends and cooled at their upper ends to a few degrees below room temperature. There are three regions of varying heat transfer arranged in order from heater to cooler: (a) supercritical (turbulent), (b) critical (laminar), and (c) subcritical (practically molecular). The temperature distribution along (a) and (c) is exponential and along (b) linear. The change in form of the heat transfer with rate of heating was investigated. The magnitude of the temperature gradient for (b), or correspondingly the magnitude of the critical Rayleigh number, completely determines the nature of the liquid motion in tubes which are inclined at 10 to 30° to the vertical. S.Weintroub

536.3 : 535.345

8030. EXPERIMENTAL VERIFICATION OF THEORETICAL RELATIONS BETWEEN TOTAL GAS ABSORPTIVITIES AND TOTAL GAS EMISSIVITIES FOR CO. U.P.Oppenheim.

J. appl. Phys., Vol. 30, No. 6, 803-7 (June, 1959).

An experimental study has been carried out for the purpose of verifying theoretical predictions concerning the relations between total absorptivities and total emissivities for transparent gases. The experimental conditions have been designed in such a way as to permit a direct check of theoretical relations derived for (a) non-overlapping dispersion lines and (b) spectral lines with sufficient pressure broadening to permit neglect of the rotational fine structure. A comparison between the emissivities derived from absorptivity measurements and emissivities calculated from the spectroscopic constants of CO shows a good agreement (within 20% for most of the temperature range). The apparatus for the measurement of total gas absorptivities is described. Results for total absorptivities of carbon monoxide measured at temperatures between 300 and 500°K are given and total emissivities have been calculated in the temperature range of 300 to 1600°K. The range of total gas pressure is 0 to 515 p.s.i.a.

536.3.08 : 537.312.5

8031. COOLED PHOTOCONDUCTIVE INFRARED DETECTORS.

W.Beyen, P.Bratt, H.Davis, L.Johnson, H.Levinstein and A.MacRae.

J. Opt. Soc. Amer., Vol. 49, No. 7, 686-92 (July, 1959).

Lead telluride as well as two types of gold–germanium infrared detectors have been constructed and their characteristics analysed. Parameters which distinguish one detector from another are spectral response, time constant, noise, and signal for a given incident power. All three materials must be cooled to about 90°K before they become useful. One type of gold–germanium detector has a long wavelength threshold at 9.5 μ, the other type and the lead telluride detector have a response extending to 6 μ. The germanium detectors owe their long wavelength response to excitation of carriers from the gold impurity states. In lead telluride, intrinsic excitation of carriers from valence to conduction band is responsible for the 6 μ threshold. Time constants of the 9.5 μ detector beyond 1.5 μ are less than 1 μsec. Time constants of the 6 μ germanium detector vary between 10 μsec and 1 msec; in lead telluride they are of the order of 15 μsec. Noise equivalent power of all three detectors is of the order of 10^{-10} W, referred to a 500°K blackbody.

536.33.06

8032. METALLIC BOLOMETERS WITH TEMPERATURE DEPENDENT THERMAL IMPEDANCE. R.Novák.

Czech. J. Phys., Vol. 7, No. 4, 432-43 (1957).

The solution is given of a bolometer with thermal impedance, which is a general function of the temperature. The general solution is applied to a bolometer cooled by radiation for which the appropriate expressions of the resistance, sensitivity and dynamic resistance are derived, and the expressions for the maximum sensitivity of this type of bolometer made from nickel, platinum and electrolytical platinum is given. The case of a bolometer cooled by conduction through the air and radiation is solved as the case of a bolometer with several ways of cooling. The paper also gives a graphico-numerical method for determining all the important parameters of the bolometer from the measured dependence of the resistance on the electric power RI^2; an example of the application of this method is given for a conduction and radiation cooled bolometer. Deviations from the theoretical course are explained by convection of heat caused by the flow of air along the bolometer due to the increase in temperature of the bolometer over that of its surroundings. The paper also gives the maximum attainable sensitivity of this type of bolometer and metallic bolometers in general.

536.413 : 548.735.4

8033. THE THERMAL EXPANSION OF SOLID CHLORINE.

L.L.Hawes and G.H.Cheesman.

Acta cryst., Vol. 12, Pt 6. 477-8 (June, 1959).

The lattice parameters of solid chlorine were determined at 77.4°, and 158.2°K, by the use of powder diffraction photographs. Values are given for the coefficients of linear and volume expansion as well as expressions relating lattice parameters and density to temperature.

536.413 : 548.735.4

THERMAL EXPANSION OF β-PLUTONIUM METAL.
See Abstr. 7649

536.42 : 532.7

8034. CELL THEORY OF CLASSICAL LIQUID. PHASE TRANSITION BETWEEN GAS, LIQUID AND SOLID. I-II.

T.Morita.

J. Phys. Soc. Japan, Vol. 12, No. 11, 1195-203 (Nov., 1957).

Cell theories of liquids have hitherto assumed that the molecules are localized near the centres of cells. In this respect, they may be considered as theories of solids. In this paper, correlations between the occupations in neighbouring cells are taken into account in the degree of Bethe approximation. This improvement of the cell theory is shown to be followed by the transitions between gas, liquid and solid; the liquid and gas states corresponding to the states where the distribution function $\rho^{(1)}(r)$ is constant throughout the volume of the system, and the solid state to the state where the distribution function $\rho^{(1)}(r)$ is localized near the centres of cells. The development of the theory is based on the cluster variation method for cooperative phenomena in the cell pair approximation. As an example, the method is applied to a system of square lattice gas. Numerical calculations are preformed for the critical point, phase diagram and second virial coefficient in a very rough approximation, where an intermolecular potential of Lennard-Jones (6-12) type is used.

536.422.15

8035. VAPOUR PRESSURES OF InAs, GaAs, InP AND GaP.

O.G.Folberth.

J. Phys. Chem. Solids, Vol. 7, No. 4, 295-300 (Dec., 1958). In German.

A new method for the measurement of the vapour-pressure of a binary compound at its melting point is described. This method, however, is only applicable if the following conditions are met. The melting process must be accompanied by a decomposition of the compound in an open system, whereas a melting without decomposition must occur, if the melting takes place in equilibrium with a vapour phase consisting almost entirely of the high-volatility component of the compound and if a certain pressure is applied. The solubilities of the components in the solid compound must be negligible. The proposed method consists substantially of a normal freezing of a melt in equilibrium with a vapour phase. Freezing processes are carried out under different pressures. If the resulting solid consists completely of a single phase, the chosen vapour pressure equals the equilibrium vapour-pressure of this compound at the melting point. The vapour-pressure can be calculated from the amount of the high-volatility component in the vapour phase during the freezing process. Measurements on some $A^{III}B^{V}$ compounds gave the following values: InAs 0.25 atm; GaAs 0.89 atm; InP > 15.5 atm; GaP > 13.5 atm. Some conclusions about the preparation and the remelting of compounds of this kind are discussed.

536.422.15

8036. THE VAPOUR PRESSURE OF TUNGSTEN TRIOXIDE.

G.Meyer, J.F.Oosterom and J.L.de Roo.

Recueil Trav. chim. Pay. Bas, Vol. 78, No. 5, 412-16 (May, 1959).

Measurements on solid tungsten trioxide between 1100° and 1250°C show that the vapour pressures cannot be calculated by extrapolation from the measurements carried out by Inoue (1949) between 800° and 850°. Conversely, the vapour pressure formula presented here is in good agreement with the measurements between 800° and 850°.

536.422.15

8037. THE VAPOUR PRESSURE OF TUNGSTEN TRIOXIDE IN GAS MIXTURES CONTAINING WATER VAPOUR.

G.Meyer, J.F.Oosterom and W.J. van Oeveren.

Recueil Trav. chim. Pay. Bas, Vol. 78, No. 5, 417-23 (May, 1959).

The increased volatility of tungsten trioxide, in an inert atmosphere containing water vapour, must be ascribed to the formation of a volatile compound. The composition of this compound is probably WO_3H_2O. The equilibrium between solid WO_3, water vapour and a gaseous compound shifts as the temperature is increased towards the formation of the compound. Thus, on lowering the temperature, the compound will break down again into anhydrous oxide and water. Hence this compound has the same empirical composition as tungstic acid (H_2WO_4). Experiments have shown that solid tungstic acid passes over into the anhydrous oxide at ~ 180° and a pressure of 10 atm. (quadruple point WO_3H_2O—WO_3—L—G). At the temperatures at which the investigation has been carried out therefore, the assumption that the gaseous compound can exist also in the solid state must be regarded as improbable.

536.423.15 : 535.343

8038. VAPOR PRESSURE, MASS, AND INFRARED SPECTRA OF HEXABORANE.

S.G.Gibbins and I.Shapiro.

J. chem. Phys., Vol. 30, No. 6, 1483-5 (June, 1959).

The vapour pressure for hexaborane over the temperature range −40°C to 16°C can be expressed by the equation $\log_{10}P\text{mm} = 5.2124 - (1566.3/T) + 0.005841\,T$. The melting point is −63.2°C; the extrapolated boiling point equals 82.2°C. The vapour pressure at 0°C is 11.85 mm instead of the published literature value of 7.2 mm. The purification of the hexaborane has been followed by infrared and mass spectra. A discussion of these spectra is given.

536.423.4

8039. COLLAPSE OF STEAM BUBBLES IN WATER.

O.Levenspiel.

Industr. engng. Chem., Vol. 51, No. 6, 787-90 (June, 1959).

The steam—water system was investigated for various degrees of instability in the temperature range 1°-20° F. Instantaneous and mean heat transfer coefficients for complete collapse were determined by photographic measurements of the progressive collapse of vapour bubbles, and were found to be dependent on bubble diameter, latent heat of vaporization and vapour density. For bubbles 1 cm in diameter, the coefficients were of the order of 10^4 B.t.u./(hr ft^2 deg F). Comparison between the present results and theoretical predictions showed no agreement.

536.423.4

8040. EXPERIMENTAL TEST OF THE VOLMER THEORY OF HETEROGENEOUS NUCLEATION.

S.Twomey.

J. chem. Phys., Vol. 30, No. 4, 941-3 (April, 1959).

The prediction of the Volmer theory that the critical supersaturation for nucleation from the vapour phase on a flat surface depends upon $(1 - \cos\phi^2)(2 + \cos\phi)$, where ϕ is the contact angle of the condensate on the surface, has been tested experimentally. Critical supersaturations for visible fogging on test surfaces coated with various transparent plastics were found to agree within observational error with the theoretical values computed for the observed contact angles.

536.461

8041. INVESTIGATION OF THE IGNITION OF A GAS BY AN ELECTRIC SPARK.

D.R.Lintin and E.R.Wooding.

Brit. J. appl. Phys., Vol. 10, No. 4, 159-66 (April, 1959).

By using flashes of microsecond duration it has been possible to obtain a series of shadowgrams showing the development of steadily propagating flames. About 100 microseconds must elapse before any difference can be detected between the flame kernels which will propagate and those which subsequently degenerate. The critical radius, at which this difference becomes apparent, has been measured in various mixtures of methane and air. The time to reach this critical stage has been determined. The flame speed has been calculated and after assuming a value for the final flame temperature, the burning velocity has been estimated. From the results obtained it has been possible to outline the mode of growth of the flame and to state which conditions favour ignition. E.R.Wooding

536.48

8042. TRANSFER OF HEAT BETWEEN THE NORMAL AND SUPERFLUID PHASES OF LIQUID HELIUM.

V.T.Khozyainov.

Dokl. Akad. Nauk SSSR, Vol. 123, No. 5, 835-7 (1958). In Russian.

Peshkov has shown experimentally (Abstr. 7351 of 1956) that a visible boundary between He I and He II can exist in the presence of a heat current. The present note describes a theory of the heat transfer across this boundary. In this theory, an instability mechanism, related to the turbulence of the He I heat flow, causes the formation, at the boundary, of small "composite systems" — regions of relatively high energy density. These "composite systems" then decompose, giving a number of rotons to the He II phase. The heat current corresponding to a temperature jump of 0.3°K is estimated from the theory, and agrees fairly well with Peshkov's measurements. O.Penrose

536.48

8043. ON THE THERMODYNAMICS OF HELIUM.

M.P.Mokhnatkin.

Zh. eksper. teor. Fiz., Vol. 36, No. 3, 963 (1959). In Russian.

Criticism of a paper by Esel'son, Kaganov, and Lifshits (Abstr. 4930 of 1958; on the ground that in some of the mathematical steps the difference between derivatives with respect to temperature taken at constant pressure and those taken at vapour-liquid equilibrium is neglected. O.Penrose

536.48

8044. ANSWER TO A LETTER OF M.P.MOKHNATKIN.

B.N.Esel'son, M.I.Kaganov and I.M.Lifshits.

Zh. eksper. teor. Fiz., Vol. 36, No. 3, 964 (1959). In Russian.

Mokhnatkin's criticism (see preceding abstract) is met by showing that the neglected quantity is in fact very small. O.Penrose

536.483 : 621.315.5

8045. OPTIMUM INPUT LEADS FOR CRYOGENIC APPARATUS.

R.McFee.

Rev. sci. Instrum., Vol. 30, No. 2, 98-102 (Feb., 1959).

Electrical leads carrying currents into cryogenic apparatus also introduce heat. The configuration of the leads which minimizes the influx of heat is derived theoretically, taking variations in thermal and electrical conductivity into account. Graphs are given for the minimum heat flow and optimum cross-section of a copper input lead carrying arbitrary current I. The optimum is found to be fairly sharp. If the diameter of the lead differs by a factor of two from the optimum, the influx of heat is increased by over 100%.

536.483

8046. USE OF NEON IN CRYOGENICS.

J.F.Dillon, Jr and V.Jaccarino.

Rev. sci. Instrum., Vol. 30, No. 2, 132-3 (Feb., 1959).

It is shown that the cost of using liquid neon as a coolant in the temperature range from 20° to 30°K is not prohibitive. A simple method of condensing the gas is described, and an example of an experiment performed with liquid neon is given.

536.51

8047. AN APPLICATION OF THE "TEMPERATURE FLOAT" AS A THERMOMETER.

L.Knop and J.Fegeš.

"J. Stefan" Inst. Rep., Vol. 2, 87-92 (May, 1955). In German.

The accuracy of the determination of heavy water in small concentrations by this method depends on accurate temperature measurements. Details of the apparatus and technique are given and it is shown that the accuracy can be increased from ±0.2 γ d to ±0.05 γ d. E.H.Dock

536.531

8048. INTERCOMPARISON OF 11 RESISTANCE THERMOMETERS AT THE ICE, STEAM, TIN, CADMIUM, AND ZINC POINTS. E.H.McLaren.
Canad. J. Phys., Vol. 37, No. 4, 422-32 (April, 1959).

Eleven standard platinum resistance thermometers, including thermometers having three different types of construction, were intercompared at the triple point of water, boiling point of water, and the liquidus points of high purity tin, cadmium, and zinc. Temperature coefficients determined from measurements at the triple and boiling points of water and the zinc point were used to calibrate the thermometers for the temperature calculations on measurements at the tin and cadmium points. The results show that, although measurements were made at a precision of about 0.0002°C at each fixed point, distinctive deviations from quadratic resistance—temperature relations were not found for the 11 thermometers. This verification of the quadratic form for the resistance—temperature relationship realized with these thermometers gives strong support for the use of the liquidus point of high purity indium, tin, or cadmium as a precision alternative to the steam point on the International Temperature Scale.

536.627

8049. ADIABATIC CALORIMETER FOR METALS IN THE RANGE — 50 TO 1000°C. E.E.Stansbury, D.L.McElroy, M.L.Picklesimer, G.E.Elder and R.E.Pawel.
Rev. sci. Instrum., Vol. 30, No. 2, 121-6 (Feb., 1959).

Designed primarily for measurements on bulk metal samples. Details of the calorimeter design and operation are given. Experimental problems associated with precise high-temperature measurements are emphasized. Measurements from room temperature to 1000°C were made and include determinations of specific heats, heat of transformation, and heats of solution. Representative data on pure nickel are shown with reported accuracy of ±0.5%.

536.627

8050. VACUUM ADIABATIC HEAT CAPACITY CALORIMETER. H.E.O'Neal and N.W.Gregory.
Rev. sci. Instrum., Vol. 30, No. 6, 434-8 (June, 1959).

The design, operation, and performance of a constant heating adiabatic vacuum calorimeter, suitable for measurement of the heat capacities of corrosive, hygroscopic, easily oxidized, and slightly volatile materials in the temperature range from 50° to 460°C, are described. A sealed glass cell is used to protect the sample.

536.628.2

8051. AUTOMATIC ADIABATIC CONTROL FOR CALORIMETER SHIELDS. L.J.Todd, R.H.Dettre and D.H.Andrews.
Rev. sci. Instrum., Vol. 30, No. 6, 463-7 (June, 1959).

An automatic adiabatic shield control has been constructed for a calorimeter designed to measure heat capacities and heats of fusion, using a combination of partial on—off control coupled with an integrating device which keeps the on-cycle equal in length to the off-cycle. A difference thermocouple is the primary source of the control impulse. By calibrating the control with zero heat input, corrections can be made for variations from absolute adiabatic states. Measurements on test compounds indicate a reduction of error due to heat leak to less than 0.1% of the heat to the sample.

536.631 : 539.21

8052. EFFECT OF NEUTRON IRRADIATION ON THE SPECIFIC HEAT OF GRAPHITE. B.B.Goodman, L.Monpetit and L.Weil.
C.R. Acad. Sci. (Paris), Vol. 248, No. 7, 956-9 (Feb. 16, 1959).
In French.

The increase in specific heat of graphite due to irradiation was measured between 20°K and 80°K for three different doses. Samples were irradiated at pile ambient temperature and the specific heat measurements were made on each sample before and after irradiation. It appears that for doses below 10^{19} neutrons cm^{-2} the increase in specific heat can be attributed to isolated interstitial atoms. J.Adam

536.631

8053. THE HEAT CAPACITIES OF SEVEN RARE-EARTH ETHYLSULPHATES AT LOW TEMPERATURES.
H.Meyer and P.L.Smith.
J. Phys. Chem. Solids, Vol. 9, No. 3-4, 285-95 (March, 1959).

Heat-capacity measurements on the ethylsulphates of lanthanum, cerium, praseodymium, neodymium, dysprosium, ytterbium, and yttrium between 1.4 and 20°K are described. In addition, specific-heat results for the cerium salt between 0.6 and 1.2°K are presented. For the salts of lanthanum and yttrium, the specific heat is entirely due to lattice vibrations, while for those of neodymium and ytterbium, there is a small contribution from magnetic interaction, negligible above 2°K. For the salts of cerium, praseodymium and dysprosium, a Schottky anomaly indicating the presence of excited electronic energy levels was found, and it was possible to determine the position of these levels with accuracy. The maximum of the Schottky anomaly of cerium and praseodymium ethylsulphates was found to be somewhat larger than the one calculated from statistical mechanics, and this specific-heat excess is discussed.

536.631

8054. A CALORIMETER FOR THE TEMPERATURE REGION 1-20°K — THE SPECIFIC HEAT OF SOME GRAPHITE SPECIMENS. W.DeSorbo and G.E.Nichols.
J. Phys. Chem. Solids, Vol. 6, No. 4, 352-66 (Sept., 1958).

A high-precision isothermal calorimeter for specific-heat measurements in the temperature range 1-20°K is described. The calorimeter container or specimen, or both, can be cooled down to the lowest temperatures without the need of exchange gas, often a source of difficulty in precision measurements made on such materials as graphite. A detailed discussion is presented on the resistance—temperature data and their analysis concerning the use of commercially available carbon resistors as secondary thermometers in both the liquid helium and liquid hydrogen temperature regions. A method is demonstrated for evolving a "working" temperature scale in the region 4.2-9.5°K, using carbon resistors. Data on three graphite specimens, obtained in the temperature range 1.3-20°K, are reported. These samples, consisting of different crystallite sizes and "degree of faulting", exhibit pronounced variations in their respective specific heats. The data for a natural graphite specimen can be expressed as a sum of two terms, aT^3 and γT. The coefficient of the linear term (electronic specific heat) is $\sim 0.6 \times 10^{-6}$ cal/(g atom deg^2). Specific-heat measurements are also reported in the liquid helium region for a boronated graphite sample.

536.631

8055. THE LOW-TEMPERATURE SPECIFIC HEAT OF GRAPHIT
J.C.Bowman and J.A.Krumhansl.
J. Phys. Chem. Solids, Vol. 6, No. 4, 367-79 (Sept., 1958).

Using the apparatus of the preceding abstract, it was noted that there were significant differences in the heat capacity of various types of graphite. The present paper deals with further experiments and theoretical analysis undertaken to identify the cause of these differences. The experimental programme was based on a set of graphite samples prepared in such a way as to control electronic and structural factors in nearly independent fashion. The results show that the major difference in heat capacity between various graphites, in the liquid-helium temperature range, is not due to electronic factors. The theoretical analysis leads to the conclusions that, first, both electronio and lattice-vibration theories are in good agreement with experiment, and, second, in lampblack graphite the random stacking of layer planes can account both qualitatively and quantitatively for the specific heat in excess of that of natural graphite. Estimated values of the elastic constants of graphite are presented.

536.631

8056. PARTICLE-SIZE EFFECT OF THE SPECIFIC HEAT OF GRAPHITE AT LOW TEMPERATURES. K.Komatsu.
J. Phys. Chem. Solids, Vol. 6, No. 4, 380-5 (Sept., 1958).

The particle-size effect of the specific heat of graphite at low temperatures (see preceding abstracts) is explained on the basis of the theory of Komatsu and Nagamiya (Abstr. 4323 of 1952). Smaller values of the elastic constants c_{44} and c_{33} are assumed for specimens of smaller sizes. With suitable choices of their values, particularly that of c_{44}, it is shown that the calculated specific-heat curves fit satisfactorily with the observed points. It is concluded that significant differences in the specific heat of various graphite specimens at low temperatures are due mostly to different values of c_{44}.

536.63

8057. LATTICE SPECIFIC HEATS NEAR 0°K WITH AN APPLICATION TO GERMANIUM. P.M.Marcus and A.J.Kennedy.
Phys. Rev., Vol. 114, No. 2, 459-67 (April 15, 1959).

Formulae for the low-temperature lattice specific heat are developed on the basis of the general adiabatic and harmonic assumptions, independently of special models or numerical procedures. Explicit simple formulae are obtained for $\theta_D(0)$, the equivalent Debye characteristic temperature at 0°K, and for the curvature of $\theta_D(T)$ at 0°K. Discussions are given of the resulting dependence of $\theta_D(0)$ on physical parameters and the significance of the formula for $\theta_D(0)$ as a check on the basic assumptions, of the absence of a linear term in $\theta_D(T)$, and of the dependence of the curvature on the dispersion of elastic waves. $\theta_D(0)$ is calculated for Ge as 374.0°K; an error of $\pm 2^\circ$K is estimated as due to errors in the elastic constants whereas the computational error is negligible. $\theta_D(T)$ is calculated for Ge for $[T/\theta_D(0)] < 0.11$ using two models. The first is a simple model of the frequency spectrum which gives results like typical force-constant models, and disagrees with measurement. The second is a model of the frequency spectrum based on the direct measurements by inelastic neutron scattering; this model shows much greater dispersion, and gives much better agreement of $\theta_D(T)$ with measurement.

536.631

8058. MEASUREMENT OF THE ATOMIC HEAT OF ZINC BETWEEN 12° AND 273°K. W.Eichenauer and M.Schulze.
Z. Naturforsch., Vol. 14a, No. 1, 28-32 (Jan., 1959). In German.

C_p for a 197 gram cylinder of 99.995% pure zinc was measured. Values of C_p and calculated values of C_v and Θ_D are tabulated.
S.Weintroub

536.632

8059. THE DETERMINATION OF THE SPECIFIC HEAT OF A LIQUID IN AN ELECTRIC CALORIMETER FROM THE TIME DEPENDENCE OF THE TEMPERATURE. F.Krupka and Z.Horák.
Czech. J. Phys., Vol. 6, No. 6, 612-19 (Dec., 1956).

It is shown that, for a well insulated calorimeter containing a liquid which is heated electrically, the temperature of the calorimeter and liquid during heating can be interpolated numerically as a function of time and hence the specific heat of the liquid can be determined. The specific heat may also be determined by comparing its temperature—time dependence with that of another liquid of known specific heat. This method assumes that the thermal leakage per unit time of the calorimeter depends only on the difference between its temperature and that of its surroundings. Measurements on naphtha are described to illustrate the methods. S.Weintroub

THERMODYNAMICS

536.7 : 530.12

THERMAL EQUILIBRIUM IN GRAVITATIONAL FIELD. RELATIVISTIC MODEL. See Abstr. 7768

536.7 : 530.162

8060. STATISTICAL MECHANICS OF SOLID AND LIQUID MIXTURES OF ORTHO- AND PARA-HYDROGEN.
A.Bellemans and A.Babloyantz.
Molecular Phys., Vol. 2, No. 2, 169-80 (April, 1959).

It is known from experimental measurements that the configurational free energy of solid and liquid mixtures of p-H_2 and o-H_2 is approximately of the form $F_{conf} = A - Bx_{o-H_2} - Cx^2_{o-H_2}$ where x_{o-H_2} is the mole fraction of o-H_2. Assuming that this dependence of F_{conf} on x_{o-H_2} is due solely to orientational forces a quantum-mechanical calculation of F_{conf} is developed which is valid for moderately low temperatures. A simplified statistical model is used consisting of a rigid lattice. The theoretical free energy obtained is however much smaller than the experimental one probably on account of the crudeness of the model. Various refinements are discussed.

536.71

8061. ON THE SECOND VIRIAL COEFFICIENT.
M.L.Goldberger.
Phys. of Fluids, Vol. 2, No. 3, 252-5 (May-June, 1959).

The second virial coefficient is calculated by a new method which exploits certain results known from formal scattering theory. In particular it is shown that the essential quantity may be expressed as the determinant of the S matrix at a given energy. The present approach suggests several approximation techniques and also seems applicable to many-body problems.

ELECTRICITY

ELECTROSTATICS . DIELECTRICS

537.2

8062. THE CALCULATION OF THE ELECTRIC POTENTIAL AND THE CAPACITY OF A TORE BY MEANS OF TOROIDAL FUNCTIONS.
S.C.Loh.
Canad. J. Phys., Vol. 37, No. 6, 698-702 (June, 1959).

Expressions in terms of toroidal functions for the electric potential and the capacity of a tore with respect to infinity are derived. Some numerical calculations of the potential are presented for tores of different sizes in order to illustrate the derived results. The electric capacity of a tore is also calculated and the numerical results are compared with those of a sphere of radius a.

537.226.08 : 621.317.37

8063. COAXIAL DISPLACEMENT DIELECTRIC CELL FOR LIQUIDS USABLE TO 250 Mc. S.E.Lovell and R.H.Cole.
Rev. sci. Instrum., Vol. 30, No. 5, 361-2 (May, 1959).

A dielectric plunger displaces liquid filling a short section of coaxial line, and dielectric constant and loss are determined from changes in measured capacitance and conductance with displacement. Corrections for imperfect plunger fit, lead capacitance, and inductance are small and well defined, and procedures for making them are given. Dielectric constants from 3 to 300 and high losses can be measured from -70° to 100°C with 3 cm^3 or less of sample.

537.226.1

8064. THEORY OF THE DIELECTRIC CONSTANT OF DILUTE SOLUTIONS. II. T.L.Hill.
J. chem. Phys., Vol. 30, No. 4, 1114 (April, 1959).

For previous part, see Abstr. 603 (1958). A short note forming an addendum to Part I, deriving an exact but formal expression for the low-field dielectric constant of a dilute solution. A statistical mechanical interpretation is available (part I) for all coefficients, but to make further progress, a particular model must be introduced. J.B.Birks

537.226.1 : 532.77

CALCULATED DIELECTRIC PROPERTIES OF DILUTE SOLUTIONS OF MACROMOLECULES. See Abstr. 7842

537.226.1

8065. THERMAL IONIC POLARIZATION AND SLOW PROCESSES IN SOLID DIELECTRICS. V.N.Lozovskii.
Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 22, No. 3, 263-7 (1958).
In Russian. English summary: PB 141041T-3, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

The author investigates a model in which a weakly bound defect ion in the dielectric has a number of potential wells available for occupation. The change in polarization due to the movement of such ions, when an electric field is applied, is calculated as a function of time. The results go to explain the so-called dielectric absorption effects, whose temperature and field strength dependence is also predicted. K.W.Plessner

537.226.1

8066. ON STABILITY OF STATES IN FERROELECTRIC CRYSTALS. V.Kh.Kozlovskii.
Zh. tekh. Fiz., Vol. 27, No. 6, 1395-9 (June, 1957). In Russian.
English translation in : Soviet Physics — Technical Physics (New York), Vol. 2, No. 6, 1290-2 (June, 1957).

The dynamical method used by the author as the basis for the theory of type I ferroelectrics (Abstr. 8585 of 1957) must be supplemented by a determination of the free energy to obtain the condition of stability. The author identifies the regions of stability in the diagrams of the previous paper. L.Pincherle

537.226.1

8067. POWDER-PATTERN TECHNIQUES FOR DELINEATING FERROELECTRIC DOMAIN STRUCTURES.
G.L.Pearson and W.L.Feldmann.
J. Phys. Chem. Solids, Vol. 9, No. 1, 28-30 (Jan., 1959).

Colloidal suspensions in insulating organic liquids have been found which produce powder patterns on polarized domains in ferroelectric crystals. Sulphur (yellow) in hexand deposits on negative dipole ends, while lead oxide (red Pb_3O_4) deposits on positive dipole ends. This technique delineates domain structures in great detail and can be used on a wide variety of ferroelectric crystals in which a domain structure has not been detected by other means. Ferroelectric crystals which have been studied by this technique include barium titanate, Rochelle salt, glycine sulphate, guanidinium aluminium sulphate hexahydrate, and numerous isomorphs. New etching techniques for barium titanate and glycine sulphate are described. Similar domain structures are revealed by etching and by powder deposit in those materials where both techniques can be used.

537.226.2

8068. DIELECTRIC DISPERSION IN GASES AT 9400 MEGACYCLES. J.E.Boggs, J.E.Whiteford and C.M.Thompson.

J. phys. Chem., Vol. 63, No. 5, 713-15 (May, 1959).

The dielectric constants of 25 gases were measured at 9400 Mc/s over a range of pressures and temperatures. Many of these gases show a lower orientation polarization at this frequency than at low frequencies. Although quantitative calculations are not possible for the asymmetric top molecules reported, the results are compared with previous observations where the dispersion was connected with molecular inversion. Certain substances, notably those with C_{2v} molecular symmetry, do not exhibit dielectric dispersion of a measurable amount, although molecular inversion should be possible.

537.226.2

8069. FERROELECTRIC PROPERTIES OF COLEMANITE. H.H.Wieder.

J. appl. Phys., Vol. 30, No. 7, 1010-18 (July, 1959).

The ferroelectric properties of the calcium borate mineral colemanite were investigated in the ferroelectric and paraelectric temperature regions. It is shown that Devonshire's phenomenological theory may be applied successfully to account for the experimental measurements of spontaneous polarization and electrical susceptibility over a wide temperature range. The thermodynamic transition is confirmed to be of second order occurring for unbiased crystals at -7°C. It is shown, in general, that the temperature τ_θ at which such a transition takes place depends upon the effective electric field E as $\tau_\theta = kE^{2/3}$ where k is a constant evaluated from Devonshire's expansion. The effect of space charge fields are evaluated and a comparison is presented between the ferroelectric properties of colemanite and those of KH_2PO_4.

537.226.2

8070. POLARIZATION REVERSAL BY SIDEWAYS EXPANSION OF DOMAINS IN FERROELECTRIC TRIGLYCINE SULFATE. A.G.Chynoweth and J.L.Abel.

J. appl. Phys., Vol. 30, No. 7, 1073-80 (July, 1959).

At fields in the range 30-35 V cm^{-1}, polarization reversal in liquid-electroded triglycine sulphate crystals is accomplished by the formation and sideways expansion of a relatively few domains. While small, the domains are elliptical or lenticular in shape, but as they grow, they tend to become irregular before amalgamating with each other. In some cases, at least, the elliptical domains have approximately equilibrium shapes as determined by the wall energy. Some general results are given concerning the sites at which the domains form and the way in which domains contract when the field is reversed.

537.226.2

8071. DIFFERENT BEHAVIOUR OF $BaTiO_3$ SINGLE CRYSTALS ON PULSED AND CONTINUOUS DUTY. V.Janovec.

Czech. J. Phys., Vol. 7, No. 5, 624-5 (1957). In German.

A change in the shape of the hysteresis loop of multidomain crystals was observed when, instead of a continuously applied alternating voltage, the voltage was only applied in short bursts. The change was towards a propeller-shaped loop, similar to that of ceramic $BaTiO_3$ which has aged without an applied field. A logarithmic dependence of peak current on time was found during the intermittent application of voltage. K.W.Plessner

537.226.2

8072. ASYMMETRIC HYSTERESIS LOOPS AND THE PYROELECTRIC EFFECT IN BARIUM TITANATE. R.C.Miller and A.Savage.

J. appl. Phys., Vol. 30, No. 6, 808-11 (June, 1959).

Dynamic pyroelectric techniques have been used to study single crystal $BaTiO_3$ hysteresis loops which have been reported in several recent investigations to be asymmetric with respect to both the polarization and electric field axes. It is shown that an apparent polarization bias occurs because of electrode-edge effects and that this bias may be shifted with an appropriate application of a d.c. field which serves to alter the direction of the polarization in fringe regions which contribute to the observed pyroelectric signal. The pyroelectric hysteresis loops are symmetric with respect to the polarization when electrode-edge effects are eliminated. These data strongly suggest that asymmetric remanent polarizations reported in several piezoelectric and pyroelectric investigations may have been due to edge effects. The pyroelectric hysteresis loops are found to be biased with respect to the electric field axis in the same manner as that reported in a recent piezoelectric study. Small residual pyroelectric signals observed at temperatures above the Curie point of the bulk material do not result from fringe effects, and the earlier interpretation of the residual signals in terms of a polarized surface layer is consistent with the present results.

537.226.2

8073. DYNAMIC PROPERTIES OF THE POLARIZABILITY IN $BaTiO_3$ CRYSTAL. K.Husimi.

J. appl. Phys., Vol. 30, No. 7, 978-81 (July, 1959).

The second harmonic distortion by a $BaTiO_3$ crystal of a small high-frequency sinusoidal electric field, superimposed on a low-frequency switching field, is studied by the filter method. From the phase relationship of the second harmonic distortion with respect to the measuring signal, together with the increase of the fundamental component of the capacitive current, it is concluded that the polarizability increases markedly for the backward direction during switc switching.

537.226.2

8074. DIELECTRIC CHARACTERISTICS OF CERAMIC MATERIALS OF THE SYSTEM CaO–BaO–TiO_2. A.A.Apsit, É.Zh.Freidenfel'd and V.Ya.Fritsberg.

Latv. PSR Zinat Akad. Vestis, No. 7(120), 119-27 (1957). In Russian.

Ferroelectric properties of CaO–BaO–TiO_2 materials are mos clearly marked for compositions containing about 50% TiO_2. Sample with compositions of metatitanates of barium ($BaTiO_3$) have maxima of ϵ at temperatures -20°, $+15^\circ$ and $+129^\circ$C. Increasing the content of CaO in the composition results in lowering the maximum of ϵ at high temperatures, and in lowering of dielectric losses and ϵ at room temperature. Compositions containing 30 to 50% of CaO show little dependence of ϵ on temperature and field strength. Compositions containing 35% TiO_2 have high losses and low ϵ; those with TiO_2 content of 65 to 90% show little dependence of ϵ on temperature over a wide temperature range. Z.Krasucki

537.226.2

8075. EFFECT OF γ-RAY AND PILE IRRADIATION ON THE COERCIVE FIELD OF $BaTiO_3$. I.Lefkowitz and T.Mitsui.

J. appl. Phys., Vol. 30, No. 2, 269 (Feb., 1959).

Irradiation of single crystals produced a decrease in coercive field and an increase in spontaneous polarization. After a fast neutron dosage of 10^{17} nvt, the hysteresis loop was deformed and double loops appeared, apparently without any change of crystal structure. The possibility that imperfections in the crystal act as nucleation sites for domains is discussed with reference to other published work. Irradiation may either produce extra sites or modify the stress field around existing sites. Study of the effects of X-ray, ultraviolet and mechanical treatment is also in progress. R.C.Kel

537.226.3

8076. THE EFFECT OF IRRADIATION ON THE DIELECTRIC LOSSES OF LUMINESCENT ZINC–CADMIUM SULPHIDE. I.Soudek.

Czech. J. Phys., Vol. 7, No. 1, 119-20 (1957).

Measurements on (Zn,Cd)S:Ag irradiated by visible light showe the dielectric losses to increase as the wavelength of the light decreased from 6000 A. At 6000 A or above the loss was less than without irradiation. S.T.Henderso

537.226.3

8077. EFFECT OF DEUTERATION ON DIELECTRIC RELAXATION IN N-PROPANOL. D.W Davidson and J.Wheeler.

J. chem. Phys., Vol. 30, No. 5, 1357-8 (May, 1959).

Like n-propanol, n-propanol-d (hydroxyl-group deuterated n-propanol) exhibits three absorption regions which are resolved o the assumption of the superposition of separate relaxation process The relaxation times, τ_1, τ_2, and τ_3 (in order of decreasing time) appearing in the expression for the frequency dependence of the complex dielectric constant are affected by deuteration. The average increase in τ_1 produced by deuteration is 19% (this value tending to increase with decreasing temp.). For τ_2 the average increase is 24% with about the same temp. dependence, and for τ_3, 23%. Mechanisms for the relaxation processes are suggested. W.Good

537.226.33

8078. DIELECTRIC RELAXATION IN SOME TWO-COMPONENT SYSTEMS. D.J.Denney.
J. chem. Phys., Vol. 30, No. 4, 1019-24 (April, 1959).

Dielectric relaxation measurements were made on a number of two-component systems involving both associated and nonassociated liquids. A single dispersion was found for a mixture containing two alkyl halides. A mixture containing an alkyl halide and an alcohol showed two dispersion regions, the separate complex plane loci being similar in form to the dispersions found for the separate components. The locus of the dispersion in several alkyl halide—hydrocarbon mixtures was not significantly different from that in the pure halides, although small deviations of unknown origin were observed at low frequencies. In the 1-propanol-2-methylpentane mixtures studied, the relative amplitudes of the multiple dispersions, characteristic of the alcohol, were little affected down to a concentration of 33 mole % 1-propanol but had changed drastically at a concentration of 14 mole % 1-propanol. The results are discussed in terms of Schallamach's suggestions concerning the molecular nature of these mixtures and the size of the liquid region involved in the dielectric relaxation process.

537.226.8

8079. EFFECTS OF HIGH ELECTRIC FIELDS ON DIELECTRIC LIQUIDS. E.T.Pierce.
J. appl. Phys., Vol. 30, No. 3, 445-6 (March, 1959).

The drop size and repetition frequency in spray from a negatively charged nozzle, towards a positive ring electrode, are determined by the relaxation time (permittivity/conductivity) of the liquid and by the amplitude of the stress applied. Electrophoretic effects are believed to occur in liquids containing ionic impurities, whereas dielectrophoretic effects are dominant in highly pure liquids (Abstr. 282/1959). J.H.Mason

537.228.1

8080. ELECTROMECHANICAL BEHAVIOR OF SINGLE CRYSTALS OF BARIUM TITANATE FROM 25 TO 160°C.
E.J.Huibregtse, W.H.Bessey and M.E.Drougard.
J. appl. Phys., Vol. 30, No. 6, 899-905 (June, 1959).

Dynamic piezoelectric resonance measurements were made on single crystals of barium titanate in the temperature range from room temperature to 160°C. In the ferroelectric region (room temperature to 120°C) the material is spontaneously polarized and hence naturally piezoelectric. For this range of temperature results are presented for the elastic compliance coefficients s_{11}^E and s_{11}^P, the combination $(2s_{12} + s_{66})$ at constant field and constant polarization, and the piezoelectric coefficient d_{31} as functions of temperature. Above the Curie temperature (120°C) the piezoelectric resonances can be observed only by polarizing the crystal with an external field. From measurements of the resonant frequencies in crystals having their longitudinal axes along the (100) and the (110) direction, and the assumption of the validity of the Cauchy relation ($c_{12} = c_{44}$), the elastic coefficients at constant polarization were determined as functions of temperature and polarization from the Curie point to 160°C. The strains induced by the polarization in a stress-free crystal are shown to be proportional to the square of the polarization, for values of polarization up to one-third of the spontaneous polarization at room temperature.

537.228.1 : 534.232

DISPLACEMENT OF THE RESONANCE FREQUENCIES OF A PLANE PIEZOELECTRIC GENERATOR ON COUPLING TO AN ACTIVE LOAD. See Abstr. 7896

537.228.1 : 539.32

EQUATIONS FOR TRANSFORMING PIEZOELECTRIC CONSTANTS OF CRYSTALS. See Abstr. 7548.

537.291 : 537.534

ELECTRODYNAMIC CONTAINMENT OF CHARGED PARTICLES. See Abstr. 7095

ELECTRIC CONDUCTION

SEMICONDUCTORS

537.311 : 536.2

ELECTRICAL AND THERMAL CONDUCTION, ANALOGY BETWEEN THE INHOMOGENEOUS LAPLACE EQUATIONS. See Abstr. 8022

537.311.1

8081. STATIC SPACE CHARGE AND CAPACITANCE FOR TWO-BLOCKING ELECTRODES. J.R.Macdonald.
J. chem. Phys., Vol. 30, No. 3, 806-16 (March, 1959).

A one-dimensional treatment is presented of space-charge effects in materials having two charge-blocking electrodes. Especial attention is given to the situation where univalent, mobile charge carriers of only one sign can recombine bimolecularly with fixed charges of opposite sign; however, the case where noncombining charges of both signs are mobile is also included. Space-charge potential distributions and differential capacitance cannot be obtained explicitly in the general case but have been accurately calculated using a digital computer. Potential versus distance and capacitance curves are presented which illustrate dependence on applied potential, separation of electrodes, and recombination ratio. The results show features often observed experimentally for a wide variety of materials such as photoconductors, semiconductors, and insulators. The treatment is applicable for much higher applied potentials than is the case for the previously considered one blocking electrode situation with charge accumulation at the blocking electrode (Abstr. 6903 of 1959).

537.311.3

8082. THE CHANGE OF RESISTANCE OF HYDROPHILIC FILMS SUBJECTED TO CONSTANT VOLTAGE. C.D.Niven.
Canad. J. Phys., Vol. 37, No. 4, 438-42 (April, 1959).

Graphs illustrate changes in resistance of gelatin and cellophane films when voltage is applied to them over a period of time and the polarity is then reversed. The similarity in these graphs, as well as other evidence, suggests that the mechanism of conduction for gelatin applies also to cellophane. Riehl's theory is very slightly modified and used to explain the results.

537.311.31

8083. THE DEVIATIONS FROM MATTHIESSEN'S RULE FOR LEAD IN THE TEMPERATURE RANGE 14°-353°K.
E.Krautz, H.Schultz and M.Kohler.
Abhandl. Braunschw. Wiss. Gesell., Vol. 8, 55-60 (1956). In German.

The deviations are measured for different concentrations of In. The departure can be described using the two-band theory of conductivity.

537.311.31

8084. VARIATION OF THE HALL COEFFICIENT OF Mg—Cd SUPERLATTICE ALLOYS WITH DEGREE OF ORDER.
K.Yonemitsu and T.Sato.
J. Phys. Soc. Japan, Vol. 13, No. 1, 15-22 (Jan., 1958).

Temperature dependence of Hall coefficient of three superlattice alloys of Mg—Cd system, Mg_3Cd, MgCd and $MgCd_3$, was measured to find the effect of order—disorder transformation upon it. At the transformation temperature, the Hall coefficient of these alloys showed a discontinuous increase in positive direction, while the electrical resistivity, which was measured simultaneously, decreased discontinuously at that temperature. It is discussed that the change of Brillouin zone structure due to the order—disorder transformation of these alloys might be considered to be the origin of such a change of the Hall coefficient.

537.311.31

8085. NEUTRON-IRRADIATION EFFECTS ON COPPER—ALUMINUM ALLOYS. M.S.Wechsler and R.H.Kernohan.
J. Phys. Chem. Solids, Vol. 7, No. 4, 307-26 (Dec., 1958).

The effect of neutron irradiation and subsequent thermal treatment on the electrical resistivity of α-phase Cu—Al alloys has been studied. It is found that a solid-state reaction that causes a decrease in resistivity is triggered or accelerated by irradiation at 32-45°C. The effect is absent in pure copper and increases with aluminum content. The resistivity decrease for the 15 atomic % aluminium alloy is about 0.2 $\mu\Omega$ cm. When the irradiation is conducted at −120°C, no decrease in resistivity is observed, but the decrease in resistivity sets in upon subsequent warming above −50°C. Several explanations for these effects are discussed.

537.311.31 : 539.2

8086. ACTIVATION ENERGIES FOR THE PRODUCTION AND MIGRATION OF VACANCIES IN PLATINUM.

A.Ascoli, M.Asdente, E.Germagnoli and A.Manara.

J. Phys. Chem. Solids, Vol. 6, No. 1, 59-64 (July, 1958).

Increases in the resistivity of platinum wires due to quenching have been measured, and the activation energy for the formation of vacancies is found to be 1.23 eV. The concentration of vacancies at the melting point is $10^{-4}-10^{-3}$. Annealing is interpreted as due to migration of single vacancies, the activation energy being 1.42 eV. The number of jumps made by the defects during annealing is $10^{7}-10^{8}$.

537.311.31

8087. ELECTRICAL RESISTIVITY OF THIN FILMS OF POTASSIUM AT 100°K. D.G.Worden and G.C.Danielson.

J. Phys. Chem. Solids, Vol. 6, No. 1, 89-95 (July, 1958).

The electrical resistivity of thin potassium films at 100°K has been measured as a function of thickness in the range 148-1600 A. The experimental results are in excellent agreement with Fuch's (1938) theoretical predictions in the range 500-1600 A and show that the scattering of the electrons at the film surfaces is completely diffuse. Comparison of experimental and theoretical curves gives a bulk resistivity parameter of 1.85 $\mu\Omega$ cm, a mean free path of 1180 A, and an electron to atomic density ratio of 1.0. The films were deposited on a Pyrex substrate from a beam of potassium vapour in a vacuum chamber which had a pressure less than 5×10^{-8} mm Hg. The film thickness, in each case, was computed from a known beam intensity, exposure time, and film density. A surface ionization detector was used to calibrate the beam intensity (J_1) as a function of effusion oven temperature (T_0). The linear plot of $\log(J_1 T_0^{1/2})$ versus T_0^{-1} gave a heat of sublimation for potassium at 450°K of 21.1 kcal/mole, in good agreement with Brewer's (1955) value of 21.4 kcal/mole within the present experimental error.

537.311.31

8088. EFFECT OF FIRST LONG PERIOD ELEMENTS ON THE RESISTIVITY OF COPPER AND OF ALUMINIUM. C.R.Vassel.

J. Phys. Chem. Solids, Vol. 7, No. 1, 90-3 (Oct., 1958). In French.

The residual resistivity of various impurities has been measured in copper (K,Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Zn, Ga, As, Se) and in aluminium (Ca, Ti, Cr, Mn, Fe, Cu, Zn). These measurements are compared with those of other workers and with the theoretical conclusions of Mott and of Friedel.

537.311.31

8089. SPIN-DEPENDENCE OF THE RESISTIVITY OF MAGNETIC METALS. R.J.Weiss and A.S.Marotta.

J. Phys. Chem. Solids, Vol. 9, No. 3-4, 302-8 (March, 1959).

The magnetic resistivity is separated from the total resistivity for ferromagnetic and antiferromagnetic metals. It is shown that the magnetic resistivity at temperatures above the Curie point is given by $\rho_{mag} = CS(S+1)$, where S is the spin and C is a temperature-independent constant having a value of 30×10^{-6} ohm cm for all transition metals and alloys and approximately 7.5×10^{-6} ohm cm for the rare-earth metals. The theory of Friedel based on an exchange interaction between the current carriers and the atomic spins is also shown to be applicable to non-half-integral spin metals such as nickel and cobalt.

537.311.31

8090. VARIATION IN THE TEMPERATURE DERIVATIVE OF RESISTIVITY. T.G.Knorr and R.W.Hoffman.

J. appl. Phys., Vol. 29, No. 10, 1512-13 (Oct., 1958).

Films of nickel and palladium up to 2500 A thick were evaporated on to glass substrates and annealed. The temperature derivative of resistivity $\Delta\rho/\Delta T$ showed a decrease with decreasing film thickness to a minimum about 10% below the bulk value, and then a very sharp increase for films so thin that their resistivity was anomalously high. C.Hilsum

537.311.31 : 536.212.2

8091. THE ELECTRICAL RESISTIVITY AND THERMAL CONDUCTIVITY OF PLUTONIUM METAL.

T.A.Sandenaw and R.B.Gibney.

J. Phys. Chem. Solids, Vol. 6, No. 1, 81-8 (July, 1958).

The electrical resistivity of two specimens of high-purity plutonium is reported for the temperature range from 26°K to approximately 780°K. These resistivity measurements give further evidence for the six allotropic modifications of solid plutonium found by thermal analysis and dilatometric measurements. Temperature coefficients of resistivity for the various phases are included, as well as indicated phase-transformation temperatures and the heat of transition for the $\alpha \to \beta$ change. Values of the thermal conductivity are given for the temperature range 110-413°K. These values are used in conjunction with resistivity measurements to calculate Lorenz numbers as a check of the Wiedemann–Franz ratio. The room-temperature resistivity of plutonium exceeds that of bismuth by 22%, but is lower than the resistivity of α-manganese by approximately the same percentage.

537.311.31 : 538.2

8092. THE TEMPERATURE DEPENDENCE OF THE ELECTRICAL RESISTANCE OF NICKEL–COPPER AND NICKEL–CHROMIUM ALLOYS AND OF THIN NICKEL AND PALLADIUM EVAPORATED FILMS, THE FERROMAGNETIC RESISTANCE ANOMALY AND THE CURIE TEMPERATURE. H.J.Bauer.

Z. Phys., Vol. 153, No. 4, 484-507 (1959). In German.

An investigation of nickel alloys containing 2 and 4% Cr and those containing 10 and 20% Cu, and also of thin Ni and Pd films (from 30 to 500 A), the resistance being measured from 400° to −185°C. A relation between ferromagnetic resistance anomaly and spontaneous magnetization is found. M.R.Hopkins

537.311.31

8093. ELECTRIC AND THERMAL RELAXATION PHENOMENA IN METALLIC CONDUCTORS CARRYING A CURRENT.

H.Göddecke.

Z. angew. Phys., Vol. 11, No 4, 143-7 (April, 1959). In German.

A small a.c. component was superimposed on the direct current flowing in a hot filament, and the a.c. impedance measured as a function of frequency. The reactance is determined by the thermal relaxation time. A simple theory is given by means of which, from the observed frequency dependence, one derives information on the cooling mechanism. L.Pincherle

537.311.32 : 539.2

8094. SOME TRANSIENT ELECTRICAL EFFECTS OF PLASTIC DEFORMATION IN NaCl CRYSTALS.

D.B.Fischbach and A.S.Nowick.

J. Phys. Chem. Solids, Vol. 5, No. 4, 302-15 (1958).

Transient electrical effects of plastic deformation in NaCl crystals have been investigated. Two effects have been observed: (1) a temporary increase in the ionic conductivity, and (2) a deformation-induced charge flow with no applied electric field. The first effect, which is observable for about an hour at room temperatur is attributed to excess vacancies freed by moving dislocations. It is suggested that an important source of these vacancies may be the breaking-up by the deformation of associated complexes between cation vacancies and multivalent cation impurities. The second effect is observed only after inhomogeneous plastic deformation, and it ceases abruptly when the stress increment producing it is removed. Possible sources for this deformation-induced charge flow are discussed, and an explanation is offered in terms of electrically charged dislocations.

537.311.33

8095. TRENDS IN SEMICONDUCTOR RESEARCH. J.Bardeen.

J. Phys. Chem. Solids, Vol. 8, 2-6, 13 (Jan., 1959).

Rochester Semiconductors Conference Paper (see Abstr. 4569/1959). This introductory address deals briefly with the development of the subject from the early 1930's to the present day, and refers, in this context, to some of the problems which are to be discussed by later papers. F.Ansbacher

537.311.33

8096. STATIONARY STATES OF SEMICONDUCTORS.

H.Brooks.

J. Phys. Chem. Solids, Vol. 8, 531-4 (Jan., 1959).

Rochester Semiconductors Conference Paper (see Abstr. 4569/1959). A review discussing the validity of band theory, band structure calculations, the chemical bond picture, available information on the band structure of various materials, impurity levels and lattice vibrations. L.Pincherle

537.311.33

8097. NARROWING THE ENERGY GAP IN SEMICONDUCTORS BY COMPENSATION. F.Stern and J.R.Dixon.

J. appl. Phys., Vol. 30, No. 2, 268-9 (Feb., 1959).

The energy gap can be decreased by the addition of large and nearly equal numbers of both donor and acceptor impurity atoms.

The bottom of the conduction band is then lowered and the top of the valence band raised, thus narrowing the energy gap, while maintaining a low carrier concentration. The effect is approximately inversely proportional to the dielectric constant and independent of the effective masses. Previous observations by other workers, as well as results reported here for InAs, agree with the simple theory. L.Pincherle

537.311.33 : 538.567

8098. THE FARADAY EFFECT IN SEMICONDUCTORS.

M.J.Stephen and A.B.Lidard.

J. Phys. Chem. Solids, Vol. 9, No. 1, 43-7 (Jan., 1959).

A general expression for the Faraday rotation, θ, in a semiconductor is derived and applied to the case of free carriers. At low magnetic field strengths and low frequencies, θ is determined by the d.c. conductivity σ_0 and the Hall coefficient R_0 and is proportional to $\sigma_0^{3/2}R_0$. At high frequencies θ depends on the electron distribution and on the shape of the energy surfaces but is independent of the relaxation mechanism. Explicit expressions are given for particular cases, and it is shown how measurements of θ at high frequencies will lead to information about energy surfaces. At low temperatures and high magnetic field strengths, resonances should appear in the rotation at the cyclotron-resonance frequencies.

537.311.33

8099. ZINC TELLURIDE AS A SEMICONDUCTOR.

J.Horák, M.Machovec and F.Kosek.

Czech. J. Phys., Vol. 7, No. 4, 468-75 (1957). In Russian.

Thin, vacuum-deposited films and sintered specimens of ZnTe were prepared from high purity materials. The temperature dependence of the electrical conductivity σ was determined, and the activation energy calculated from the slope of the log σ/T curve was $W \cong 0.26$ eV. The thermo-e.m.f. measured in the 20-50° C temperature interval was ~ 0.5 mV/°C, and its polarity indicated that ZnTe is characterized by p-type conductivity. The lattice parameter of ZnTe, determined by X-ray measurements, was a = 6.085 A. M.H.Sloboda

537.311.33

8100. THE PREDICTION OF SEMICONDUCTING PROPERTIES IN INORGANIC COMPOUNDS. C.H.L.Goodman.

J. Phys. Chem. Solids, Vol. 6, No. 4, 305-14 (Sept., 1958).

Various criteria are presented for predicting possible semiconducting behaviour in inorganic compounds. Semiconductors have saturated ionic-covalent bonding which requires that they can be presented by an ionic formula; they occur as "line phases" in the appropriate constitutional diagram. It is also shown that various series of new semiconducting compounds can be derived from known ones by a process of "cross-substitution", i.e. by replacing one element by pairs from other groups of the Periodic Table while keeping the valence-electron/atom ratio constant. The application of these concepts is illustrated with particular reference to diamond-type lattices, some seven of which are discussed, though other structures are also considered.

537.311.33 : 548.736.3

8101. THE CRYSTAL STURCTURE AND PROPERTIES OF THE GROUP VB TO VIIB ELEMENTS AND OF COMPOUNDS FORMED BETWEEN THEM. E.Mooser and W.B.Pearson.

J. Phys. Chem. Solids, Vol. 7, No. 1, 65-77 (Oct., 1958).

The crystal structures of the Group VB to VIIB elements and of compounds formed between them are discussed on the basis of the valence-bond theory. A consistent bond scheme is proposed and applied to derive qualitative band structures for these materials. The band structures, which in many cases deviate from the usual semiconductor band model, afford a satisfactory interpretation of the anomalous electrical and optical properties observed in some of the substances under consideration. Thus, for instance, they provide an explanation of the anomalous sign reversals of the Hall coefficients observed in both tellurium and Bi_2Te_3. Semiconducting properties are predicted for a series of ternary compounds.

537.311.33

8102. ANALYSIS OF THE SEMICONDUCTING PROPERTIES OF COBALT FERRITE. G.H.Jonker.

J. Phys. Chem. Solids, Vol. 9, No. 2, 165-75 (Feb., 1959).

From measurements of resistivity, activation energy, and Seebeck effect, an energy-level scheme is derived by which the semiconducting properties of $CoFe_2O_4$ can be described. These properties differ considerably from those of normal semiconductors, as the charge carriers are not free to move through the crystal lattice but jump from ion to ion.

537.311.33 : 538.2 : 548.736.3

8103. CRYSTAL STRUCTURE AND MAGNETIC SUSCEPTIBILITY OF RECTIFYING CUPROUS OXIDES.

K.R.Dixit and V.V.Agashe.

Indian J. Phys., Vol. 31, No. 9, 466-82 (Sept., 1957).

Oxides of copper were prepared in air at 0.5 mm Hg in the temperature range 200° to 1030° C. Their composition, rectification, magnetic susceptibility and crystal structure — all these as a function of the thickness of the film and their subsequent heat treatment — were studied. The films formed at 800° C begin to show an appreciable rectification, which increases rapidly with the temperature of formation of the film. The appearance of an appreciable amount of rectification is accompanied by changes in the crystal structure at the surface and in the body of the film. There is also a characteristic change of the magnetic susceptibility. In a rectifying film the surface layer contains large Cu_2O crystals showing 111 orientation, while in the body of the film, small crystallites of Cu_2O, containing traces of excess oxygen and showing a zinc blende structure, are present. The effect of heat treatment is to reduce the oxygen content and increase the diamagnetic susceptibility. The presence of an additional atom of oxygen in each crystallite of Cu_2O appears to give the maximum rectification. A mechanism for the formation of these rectifying films is suggested.

537.311.33 : 535.343

8104. PREPARATION AND PROPERTIES OF HgTe AND MIXED CRYSTALS OF HgTe—CdTe.

W.D.Lawson, S.Nielsen, E.H.Putley and A.S.Young.

J. Phys. Chem. Solids, Vol. 9, No. 3-4, 325-9 (March, 1959).

The elements mercury, cadmium, and tellurium have been purified, and crystals of the compounds CdTe and HgTe, and of the mixed compounds CdTe—HgTe have been prepared. X-ray and cooling-curve data have established that CdTe and HgTe mix in all proportions to give single-phase crystals. Hall-coefficient and conductivity measurements show that HgTe is a semiconductor with a very low activation energy (~ 0.01 eV) and a high mobility ratio (~ 100). HgTe is opaque to infrared radiation out to a wavelength of 38 μ, but the mixed crystals show absorption edges which vary in position with composition from 0.8 μ in pure CdTe to 13 μ in crystals containing 90% HgTe. Photoconductivity has been observed in filamentary detectors made from the mixed crystals.

537.311.33

8105. OPTICAL INVESTIGATION ON THE SEMICONDUCTING PROPERTIES OF As AND Zn_3As_2 FILMS. G.Harbeke and G.Lautz.

Abhandl. Braunschw. Wiss. Gesell., Vol. 7, 36-45 (1955). In German.

Reports optical measurements of ΔE. X-ray and optical investigations on these layers, produced in high vacuum, confirm their crystalline structure, their homogeneity and the formation of the compound Zn_3As_2. The optical constants of As and Zn_3As_2 are calculated from reflection and transmission curves in the region from 0.5 to 2.7 μ. Assuming the threshold wavelength belonging to an absorption constant $K = 1\ \text{mm}^{-1}$, the authors obtain for As $\lambda_g = 1.16\ \mu$, corresponding to $\Delta E = 1.07$ eV, and for Zn_3As_2 $\lambda_g = 2.44\ \mu$, which corresponds to 0.51 eV. The experimental results are discussed in comparison with previous electrical and optical measurements on the amorphous As.

537.311.33 : 535.32

8106. ON THE DETERMINATION OF THE OPTICAL CONSTANTS OF SEMICONDUCTORS. F.Lukeš.

Czech. J. Phys., Vol. 7, No. 3, 371-2 (1957).

It is shown that the refractive index and extinction coefficient can be expressed simply in terms of the intensity of reflected and transmitted light, even if interference effects occur. C.Hilsum

537.311.33

8107. ANALYSIS OF INTRINSIC RECOMBINATION RADIATION.

J.R.Haynes, M.Lax and W.F.Flood.

J. Phys. Chem. Solids, Vol. 8, 392-6 (Jan., 1959).

Rochester Semiconductors Conference Paper (see Abstr. 4569/1959). The intrinsic recombination radiation from specimens of Ge and Si is measured from 10°-70°K (Ge) and 44°-215°K (Si). From the results phonon energies are calculated, the results for Ge agreeing well with the optical absorption values of Macfarlane, McLean, Quarrington, and Roberts (see Abstr. 4953 of 1958), but those for Si are rather higher. C.A.Hogarth

537.311.33

8108. A NOTE ON THE THEORY OF THE ANOMALOUS THERMOELECTRIC PHENOMENON IN SEMICONDUCTORS.

J.Tauc.

Czech. J. Phys., Vol. 7, No. 3, 376-7 (1957). In Russian.

An earlier paper (Abstr. 6635 of 1954) described the anomalous variation of the thermo-e.m.f., ΔU, with temperature that had been observed in n-type Ge in the case when a tungsten point constituted the cold electrode, and attributed this effect to the thermo-emission of holes. In the present note, an expression is derived which describes the temperature dependence of ΔU, and which is in qualitative agreement with experimental results previously obtained.

M.H.Sloboda

537.311.33 : 621.316.5 : 621.382

8109. HIGH-SPEED MICROWAVE SWITCHING OF SEMICONDUCTORS. II. R.V.Garver.

I.R.E. Trans Microwave Theory and Tech., Vol. MTT-7, No. 2, 272-6 (April, 1959).

For Pt I, see Abstr. 3125 (1959). A relationship between low-power isolation and small-signal, low-frequency diode resistance is reported. A study of ambient heating indicates that with increasing temperature the diode characteristics tend to approach the line characteristic of the above relationship. Observed switching speeds of 1.5 to 3.0 mμsec are reported. A theory is presented which agrees with the switching time data and predicts microwave switching times as low as 0.2 to 0.3 mμsec. High speed switching is discussed with reference to significant parameters, e.g., hole storage, internal heating, and pulse reverse diode characteristics.

537.311.33

8110. MICROPLASMA FLUCTUATIONS IN SILICON.

K.S.Champlin.

J. appl. Phys., Vol. 30, No. 7, 1039-50 (July, 1959).

The electrical properties of a fluctuating bistable microplasma are specified by three parameters which, in general, are functions of voltage. For an ideal low impedance connection, these parameters are independent of time and thus yields simple forms for the pulse rate, average current, differential conductance, and noise spectral density. With a high impedance circuit the phenomenon is more complex, and only an approximate analysis is offered. Measurements on alloyed junctions with breakdown voltages between 7.9 and 10.5 V show that single breakdown regions sometimes occur at low currents. Multistable conduction as well as the simpler bistable conduction is observed. The multistable conduction is characterized by fluctuations among higher current levels which occur at a rate 10^2-10^5 times faster than the "on—off" fluctuations. Excellent agreement between measured and calculated current spectral density at low impedance is found. This justifies the assumptions of random events independent of previous "on" or "off" time and suggests that noise spectrum measurements at low impedance be used as a tool for accurately determining the microplasma parameters. With a high impedance connection, the process is not Markoffian; thus the noise is not simply related to the noise at low impedance. The event which initiates breakdown is found to be field dependent suggesting that field emitted carriers are involved. It is shown that the results do not fully agree with those predicted by Rose's model of a microplasma.

537.311.33

8111. MICROWAVE TECHNIQUES IN MEASUREMENT OF LIFETIME IN GERMANIUM. A.P.Ramsa, H.Jacobs and F.A.Brand.

J. appl. Phys., Vol. 30, No. 7, 1054-60 (July, 1959).

New techniques are proposed for the measurement of lifetime in semiconductors by utilizing the absorption of microwave power by charge carriers. The densities of holes and electrons are varied by irradiation with light or the conduction mechanism. Agreement is found when the microwave absorption methods are compared with the more established photoconductivity decay techniques. One of the new methods offers an advantage in that electrode attachments are no longer required.

537.311.33 : 621.315.59

8112. TECHNIQUE FOR PRESERVING LIFETIME IN DIFFUSED SILICON. S.J.Silverman and J.B.Singleton.

J. Electrochem. Soc., Vol. 105, No. 10, 591-4 (Oct., 1958).

After a silicon crystal has been grown, contamination prior to and during the diffusion process is considered a significant cause of lifetime degradation. If, prior to diffusion, a suitable gettering agent is formed on the surface of a silicon slice, then the resultant average lifetime is approximately an order of magnitude greater than that in an untreated slice from the same crystal subjected to the same process. It is believed that a metal—silicon liquid phase established on the silicon surface getters recombination centres from within the bulk of the material, thereby preserving the lifetime. Nickel, silver, or bismuth has been independently applied with comparable results.

537.311.33

8113. LIFETIME MEASUREMENTS OF MINORITY CARRIERS ACROSS AND ALONG A DISLOCATION WALL IN A GERMANIUM CRYSTAL. R.R.Hasiguti and E.Matsuura.

J. Phys. Soc. Japan, Vol. 12, No. 12, 1347-51 (Dec., 1957).

Measurements were made on an n-type germanium crystal. The spacing of dislocations in the wall was about 2×10^{-4} cm. The recombination diameter of a dislocation in the dislocation wall was 2.2×10^{-8} cm. The lifetime was unusually large (about 210 μsec), when measured along the wall. The usual value of lifetime was about 70 μsec, in this specimen. It is suggested that the dislocation wall forms a p-type thin layer in an n-type crystal.

537.311.33

8114. INFLUENCE OF ATOMIC HYDROGEN ON THE CONDUCTIVITY OF CLEANED GERMANIUM SURFACES.

G.Heiland and P.Handler.

J. appl. Phys., Vol. 30, No. 3, 446-7 (March, 1959).

Experiments are described which show that atomic hydrogen acts as an acceptor on a Ge surface which has been cleaned by argon bombardment and annealed at 600°C. On surfaces which have not been cleaned, the hydrogen acts as a donor. The original state may be restored by a short heat treatment at 550°C. A tentative explanation of the effects is given.

C.Hilsum

537.311.33

8115. SOME EFFECTS OF OXYGEN ON RESISTIVITY IN SILICON. D.H.Roberts and B.L.H.Wilson.

J. appl. Phys., Vol. 30, No. 3, 447-8 (March, 1959).

Experiments on specimens of high-quality silicon before and after annealing suggest that the oxygen content can affect the resistivity of silicon, possibly by acting as an acceptor.

C.A.Hogarth

537.311.33

8116. ELECTRICAL PROPERTIES OF $FeTiO_3$—Fe_2O_3 SOLID SOLUTION SERIES. Y.Ishikawa.

J. Phys. Soc. Japan, Vol. 13, No. 1, 37-42 (Jan., 1958).

D.C. electrical conductivity and Seebeck voltage of the synthesized solid solution $x\ FeTiO_3\cdot(1-x)Fe_2O_3$ of ilmenite ($FeTiO_3$) and hematite (Fe_2O_3) were measured for a composition range of $1 \geq x \geq 0.33$. It was found that both conductivity and Seebeck voltage change continuously with the composition. At room temperature, the conduction is p type for $x > 0.73$ and n type for $x < 0.73$. Judging from these results, it was concluded that the valence state of Ti ions in the compound is tetravalent for the whole range of composition. Conductivity of all specimens obeys a simple Wilson's formula $\sigma = \sigma_0 \exp(-E/2kT)$ over a temperature range from 200°K to 970°K with two or three activation energies for each specimen. No anomalous change of conductivity could be observed at the ferrimagnetic or antiferromagnetic Curie point. It was, therefore, expected that the conduction electrons do not correlate with the magnetic spins in these compounds. Conductivity and Seebeck voltage of both ordere (ferrimagnetic) and disordered (antiferromagnetic) specimens with the same composition were compared. It was found that change of the ion arrangement does not affect electrical properties of these compounds.

537.311.33

8117. THE MAGNETO-RESISTANCE OF ELECTRONS IN InP AND GaAs. M.Glicksman.

J. Phys. Chem. Solids, Vol. 8, 511-15, 530 (Jan., 1959).

Rochester Semiconductors Conference Paper (see Abstr. 4569/1959). Room temperature measurements on n-type InP and GaAs as a function of crystal orientation indicate that in both materials the conduction band is spherically symmetrical in k-space and that the scattering is only weakly dependent on energy.

C.A.Hogarth

537.311.3

8118. ON THE ANOMALOUS TEMPERATURE DEPENDENCE OF THE HALL COEFFICIENT OF LIGHTLY DOPED P-TYPE InAs.

H.Rupprecht.

Z. Naturforsch., Vol. 13a, No. 12, 1094-6 (Dec., 1958). In German.

The second sign reversal of the Hall effect, reported by

Folberth and Weiss (Abstr. 8199 of 1956), can be eliminated by etching the specimen surface, and it can be restored by treatment with emery paper. The conductivity is not affected. K.W.Plessner

537.311.33

8119. RESISTIVITY AND HALL COEFFICIENT OF ANTIMONY-DOPED GERMANIUM AT LOW TEMPERATURES. H.Fritzsche.

J. Phys. Chem. Solids, Vol. 6, No. 1, 69-80 (July, 1958).

The Hall coefficient R and resistivity ρ of germanium single crystals containing between 5×10^{14} and 10^{18} antimony atoms per cm^3 were reinvestigated at temperatures between 1.3 and 300°K. The low-temperature anomalies — a steep maximum in the log R versus 1/T curves and a change of slope of the log ρ versus 1/T curves — are discussed on the basis of impurity conduction. Two different processes of impurity conduction could be distinguished by adding compensating p-type impurities to n-type germanium and investigating the resulting change of ρ at low temperatures. At small impurity concentrations (small overlap of electron wave functions of neighbouring impurities), impurity conduction is possible only if compensating impurities produce empty majority centres. Addition of a small number of compensating impurities to a specimen containing 8.5×10^{16} antimony atoms/cm^3 produced a decrease of the resistivity of impurity conduction because of the increased concentration of empty majority centres. At large impurity concentrations (strong overlap), the localization of the carriers is removed, so that they can migrate through the crystal without the presence of compensators. Addition of compensating impurities to a specimen containing 1.2×10^{17} antimony atoms/cm^3 caused the resistivity of impurity conduction to increase because of the decrease in carrier concentration and the increase in the number of scattering centres. Qualitative agreement is found between impurity conduction in antimony-doped germanium and that in gallium-doped germanium previously reported. A quantitative comparison was, however, not possible because the degree of compensation could not be determined with sufficient accuracy.

537.311.33

8120. MEASUREMENT OF SURFACE RECOMBINATION VELOCITY IN SILICON BY STEADY-STATE PHOTOCONDUCTANCE. H.M.Bath and M.Cutler.

J. Phys. Chem. Solids, Vol. 5, No. 3, 171-9 (May, 1958).

A method of minority-carrier lifetime measurement is presented which uses the steady-state enhancement of conductivity produced by optical excitation. The illumination may be of two types, bulk-generating and surface-generating, which produce excess minority-carrier distributions dependent primarily on the bulk and surface properties, respectively, of the sample filament. In applying the method to silicon, it was found that the surface velocity behaves in a manner different from that of germanium. The value of s is dependent on the concentration of added minority carriers, even though the fractional change in conductivity is small. In the sample studied, the surface velocity had the form $s = kC$ for values of C larger than approximately 10^{11} cm^{-3}, where C is the concentration of added minority carriers near the surface.

537.311.33

8121. FIELD EFFECT AND PHOTOCONDUCTION IN ZnO SINGLE CRYSTALS. G.Heiland.

J. Phys. Chem. Solids, Vol. 6, No. 2-3, 155-68 (Aug., 1958). In German.

It has been shown that atomic hydrogen produces an n-type accumulation layer on the surface of ZnO crystals. The high surface-conductivity associated with this layer can be lowered by adsorption of oxygen or by heating in a vacuum. In this way the surface conductance, which is large compared to the bulk conductance at 90°K, is varied over a range of five orders of magnitude. Three different methods are used to change carrier density at the surface without changing the gas coverage: field-effect, photoexcitation with chopped light and photoexcitation with steady illumination. From field-effect (change of carrier density due to transverse electric fields) and from surface photoconduction, using chopped light in the intrinsic absorption region, a drift mobility is derived. The results of these two methods are in good agreement. The drift mobility increases with increasing surface conductivity for several orders of magnitude and reaches 30 cm^2/Vsec. Measurements of surface photoconduction, using continuous irradiation in the intrinsic absorption region, combined with the drift mobility, yield information on the density and lifetime of excited electrons at the surface. As the irradiation intensity is increased through four orders of magnitude, the lifetime decreases from 0.5 to 7×10^{-4} sec. However, if the surface conductivity is changed by four orders of magnitude by adsorption or desorption, the lifetime remains constant and is therefore independent of adsorbed gases. A consistent explanation of the results is possible with a surface model containing two sets of continuously distributed surface states, one just below the conduction band and one just above the valence band. An estimation for the density of these fast surface states is given.

537.311.33

8122. TECHNIQUE FOR MEASURING PARTICLE DRIFT MOBILITIES IN NEAR INTRINSIC AND NARROW BAND GAP SEMICONDUCTORS. N.J.Harrick.

J. appl. Phys., Vol. 30, No. 3, 451-2 (March, 1959).

Discusses the relation between ambipolar and particle drift mobilities and shows how reliable values of particle drift-mobility may be obtained by a carrier extraction (exclusion) technique. C.A.Hogarth

537.311.33

8123. CORRELATION BETWEEN MOBILITY AND EFFECTIVE MASS IN SEMICONDUCTORS. R.W.Keyes.

J. appl. Phys., Vol. 30, No. 3, 454 (March, 1959).

The lattice mobility (μ) at room temperature for electrons in Si, Ge, InAs and InSb, heavy holes in Si and Ge, and light holes in Si, obeys the empirical relation $\mu = (m^*/m_0)^{-1.35}$ cm^2/V sec, where m^*/m_0 is the effective mass ratio. R.Stratton

537.311.33

8124. DRIFT VELOCITY SATURATION IN p-TYPE GERMANIUM. R.D.Larrabee.

J. appl. Phys., Vol. 30, No. 6, 857-9 (June, 1959).

A method of making an ohmic contact to a semiconductor that does not inject minority carriers at high current densities has been found. This surmount difficulties and limitations of previously reported experiments. Utilizing this technique, the high field current—voltage characteristic of p-type germanium was measured at several temperatures from room temperature to liquid helium temperatures, a wider range than previously reported. From these data, the drift velocity (and drift mobility) can be computed as a function of electric field and also the amount of heating estimated that will occur when a square pulse of current is passed through a p-type germanium sample immersed in liquid helium.

537.311.33

8125. ANISOTROPIC MOBILITIES IN PLASTICALLY DEFORMED GERMANIUM. R A.Logan, G.L.Pearson and D.A.Kleinman.

J. appl. Phys., Vol. 30, No. 6, 885-95 (June, 1959).

The carrier density was measured as a function of temperature in n-type germanium which had been plastically deformed by bending. It can be accounted for on the basis of Read's theory (Abstr. 9754 of 1954; 1351 of 1955) if the dislocation acceptor level lies 0.18 to 0.20 eV below the conduction band. The analysis indicates that the dislocation density introduced by plastic bending is about 8 times the theoretical equilibrium density that would correspond to zero internal stress. The mobility for current flow along the bending axis was observed to be the normal mobility, which indicates that the dislocations are parallel to the bending axis, although they may zig-zag with line segments along (110) type directions. The mobility perpendicular to the bending axis is in qualitative agreement with the theory given by Read, although the theory tends to underestimate the reduction of mobility below 50°K. Read's theory is extended to the case where the current flows along the bending axis and the magnetic field is perpendicular to the bending axis.

537.311.33

8126. RESISTIVITIES AND HOLE MOBILITIES IN VERY HEAVILY DOPED GERMANIUM. F.A.Trumbore and A.A.Tartaglia.

J. appl. Phys., Vol. 29, No. 10, 1511 (Oct., 1958).

Single crystals were doped with up to 5×10^{20} atoms/cm^3 of In, Al, or Ga. The carrier concentration as determined from the degenerate formula for Hall effect agreed with the impurity concentration measured by spectroscopic or chemical analysis, showing that each acceptor centre gives rise to one hole. The dependence of hole mobility on impurity concentration is given. In the most impure specimen the mobility was 48 cm^2/V sec. C.Hilsum

537.311.33

8127. ELECTRON MOBILITIES IN GALLIUM ARSENIDE. L.R.Weisberg, J.R.Woolston and M.Glicksman.

J. appl. Phys., Vol. 29, No. 10, 1514-15 (Oct., 1958).

Uncompensated single crystals with electron concentrations down to 4×10^{17} cm^{-3} were made by directional freezing. The dependence of mobility on carrier concentration was used to predict the lattice mobility and the effective mass, which were, respectively, 12 500 cm^2/V sec and 0.06 m. C.Hilsum

537.311.33

8128. MICROWAVE FIELD DEPENDENCE OF DRIFT MOBILITY IN GERMANIUM. K.Seeger.
Phys. Rev., Vol. 114, No. 2, 476-81 (April 15, 1959).

At lattice temperatures between 80° and 300°K, electrons and holes in germanium were heated by microwaves, with an extension to high microwave fields of the technique developed by Morgan. The microwave frequency was 34.67 kMc/s. The effect of carrier densities between 10^{13} and $10^{16}/cm^3$ was investigated. At large microwave fields E (up to about 10^4 V/cm in amplitude) the mobility μ, relative to the mobility μ_0 at zero field, is proportional to $E^{-\gamma}$; the exponent γ is smaller for purer samples. These microwave measurements agree with previous d.c. field measurements. At small values of E, $(\mu_0-\mu)/\mu_0E^2 \equiv \alpha$ is field independent. The variation of α with lattice temperature T was measured. In the range of pure lattice scattering, $\alpha(T) \propto \mu_0^2T^x$, $\exp x = (n/n_0)^{0.67}$ where $n_0 = 1.7 \times 10^{14}$ cm^{-3} for electrons and 1.0×10^{14} cm^{-3} for holes. This dependence on carrier density suggests that carrier—carrier interaction plays an important role in the carrier—phonon scattering mechanism.

537.311.33

8129. LATTICE MOBILITY OF HOT CARRIERS. E.Conwell.
J. Phys. Chem. Solids, Vol. 8, 234-9, 262-3 (Jan., 1959).

Rochester Semiconductors Conference Paper (see Abstr. 4569 of 1959). The results of a calculation of the effect of intra-valley optical mode scattering on lattice mobilities in germanium are presented. Graphs are shown which suggest that, by combining the effects of optical and acoustical modes, a fairly satisfactory explanation can be given for the dependence of the mobility on electric field up to fields of the order of 7×10^4 volts/cm.

P.T.Landsberg

537.311.33

8130. TRANSPORT OF ELECTRONS IN INTRINSIC InSb. H.Ehrenreich.
J. Phys. Chem. Solids, Vol. 9, No. 2, 129-48 (Feb., 1959).

The mobility, thermoelectric power, Hall coefficient, and far infrared reflectivity of InSb are calculated, taking account of the non-parabolic conduction band as well as the correct wave functions of the electrons. Lattice scattering by polar modes and electron-hole scattering, previously shown to be the dominant mechanisms between 200 and 700°K, are properly combined in a variational transport calculation. Screening effects of the intrinsic carriers on the electron-phonon interaction are considered explicitly. A modified form of Kohler's variational principle is introduced, and the sensitivity of the calculated transport properties to several choices of trial functions is investigated. The Hall coefficient for weak magnetic fields is obtained from a new variational principle, the results being used to correct the experimental Hall mobility. The calculated mobility and thermoelectric power for the effective ionic charge determined from optical experiments agree well with experiment. The theory in its present form contains no adjustable parameters. The Boltzmann equation for high-frequency conduction is solved by means of a perturbation technique. The reflectivity minimum of InSb in the far infrared is calculated and found to agree well with experiment.

537.311.33

8131. SLOW CAPTURE OF HOLES AND ELECTRONS BY SURFACE STATES ON GERMANIUM AND SILICON AT LOW TEMPERATURES. S.R.Morrison.
Phys. Rev., Vol. 114, No. 2, 437-44 (April 15, 1959).

Field-effect decay curves at temperatures of the order of liquid nitrogen are presented for n- and p-type germanium and for p-type silicon. A strongly asymmetric decay is observed, depending upon whether the induced charge is positive or negative. The decay is strongly influenced by illumination, temperature, and magnitude and sign of the field. Injected minority carriers also affect the decay rate. It is suggested that the trapping centres involved are the fast states, or recombination centres at the surface. After a disturbance of the charge in these states the approach to steady state is slow due to the limited supply of minority carriers arriving at the surface. The results observed are compared with a model which takes surface barrier effects into consideration and are found in reasonably quantitative agreement.

537.311.33

8132. CONCENTRATION AND MOBILITY OF ELECTRONS IN ZINC OXIDE SINGLE CRYSTALS OF DEFINITE COMPOSITION. H.Rupprecht.
J. Phys. Chem. Solids, Vol. 6, No. 2-3, 144-54 (Aug., 1958).
In German.

The electrical conductivity and Hall effect of synthetic crystals of zinc oxide with foreign atoms have been measured from 65° to 700°K. Similar results to other semiconductors, such as germanium and silicon, are found. The values of carrier concentration and mobility deduced are compared with the well-known theoretical formulae. It is possible with certain assumptions to deduce a value for the electron effective mass.

537.311.33

8133. EFFECTS OF ELECTRON—ELECTRON SCATTERING ON THE ELECTRICAL PROPERTIES OF SEMICONDUCTORS. R.W.Keyes.
J. Phys. Chem. Solids, Vol. 6, No. 1, 1-5 (July, 1958).

In an attempt to account for some discrepancies between the predictions of the ordinary relaxation-time theories and experiment, a term which represents the effect of electron—electron collisions is added to the Boltzmann equation. The modified equation is solved and results for the spherical and germanium band structures are given. Some effects are produced in the germanium band structure which are qualitatively similar to those actually observed in the impurity-scattering region. The new effects in the theory are neither a complete nor a unique explanation of the effects, however.

537.311.33

8134. THE DIRECT AND INDIRECT TRANSITION EXCITONS IN GERMANIUM. S.Zwerdling, L.Roth and B.Lax.
J. Phys. Chem. Solids, Vol. 8, 397-400 (Jan., 1959).

Rochester Semiconductors Conference Paper (see Abstr. 4569/1959). Brief description of the high-resolution magneto-spectrophotometric system and helium cryostat used by the authors together with recent significant results on exciton energies in germanium. In a preliminary measurement on silicon, the exciton edge at zero magnetic field was centred on 1.2053 ± 0.0006 eV but the magneto-absorption was too small for quantitative measurement at 38.9 kOe.

C.A.Hogarth

537.311.33

8135. CROSS MODULATION OF D.C. RESISTANCE BY MICROWAVE CYCLOTRON RESONANCE. H.J.Zeiger, C.J.Rauch and M.E.Behrndt.
J. Phys. Chem. Solids, Vol. 8, 496-8 (Jan., 1959).

Rochester Semiconductors Conference Paper (see Abstr. 4569 of 1959). A slightly fuller account of the work described in Abstr. 6969 (1958).

R.G.Chambers

537.311.33

8136. MEASUREMENT OF THE GALVANOMAGNETIC EFFECTS IN PURE TELLURIUM. H.Roth.
J. Phys. Chem. Solids, Vol. 8, 525-29, 530 (Jan., 1959).

Rochester Semiconductors Conference Paper (see Abstr. 4569/1959). Discusses generally how the galvanomagnetic effects i Te are expected to vary with temperature and with different current axes in the crystal. The galvanomagnetic coefficients are calculate for 303° and 78°K and a field of 5000 Oe from results of Hall coeffic ent, conductivity, and magnetoresistance, as a function of orientati of the crystal. The conduction band of Te can be described by one ellipsoid of revolution about the c-axis but a more complicated structure must be assumed for the valence band.

C.A.Hogart

537.311.3

8137. INFLUENCE OF THE AMBIENT ATMOSPHERE ON THE SURFACE RECOMBINATION OF SILICON. H.U.Harten.
Philips Res. Rep., Vol. 14, No. 3, 207-10 (June, 1959).

From measurements of the surface photo-voltage it follows tha the surface potential of silicon can be altered, similarly to that of germanium, in a wide range by chemical surface treatments and in a smaller range by the ambient atmosphere. Simultaneous investigation of the surface recombination shows this process to be determined chiefly by recombination centres of the Hall—Shockley—Read type.

537.311.33 : 539.21

GERMANIUM AND SILICON SURFACES. See Abstr. 7522

537.311.33

8138. STATISTICAL THEORY OF AVALANCHE BREAKDOWN IN SILICON. R.E.Burgess.

Canad. J. Phys., Vol. 37, No. 6, 730-8 (June, 1959).

The current flowing in silicon junctions under conditions of high electric field sufficient to cause avalanche breakdown consists of a sequence of pulses of constant magnitude and with randomly distributed spacing and duration. A statistical model is presented for this intermittent conduction mechanism in which the transition probabilities between the conducting and non-conducting states are Markoffian and depend on the excess of the applied voltage over the breakdown voltage; power-law and exponential dependences are considered and the precise form is shown not to be critical in deriving from these simple conditions a number of predictions about the macroscopic current—voltage characteristic, all of which have been confirmed by experiment. It is demonstrated generally that a randomly switched discharge of positive resistance has a macroscopic current—voltage characteristic which depends upon the d.c. source resistance and can have a region of negative slope. Only with a negligible small source resistance is the true characteristic obtained. The observable fluctuations of current and their spectral distribution are derived and indicate the noisiness of silicon junctions under avalanche conditions.

537.311.33

8139. THE EFFECT OF UNIAXIAL TENSILE STRESS ON IMPURITY CONDUCTION IN GERMANIUM. H.Fritzsche.

J. Phys. Chem. Solids, Vol. 8, 257-9, 262-3 (Jan., 1959).

Rochester Semiconductors Conference Paper (see Abstr. 4569/1959). Report given of measurements of the piezoresistance $\rho\chi$ of n-type germanium containing 1.4×10^{16} Sb atoms/cm^3 and 2 - 6% compensation at temperatures down to 1.3°K. Tensile stress up to 3×10^8 dynes cm^2 was applied in the (1, 1, 0) direction and three directions of the current were considered. In the range of impurity band conduction, $\rho\chi/\rho_0$ has the form $\exp(\epsilon/kT)$. The relation of these results to the band structure of germanium and to the splitting of the impurity ground state is discussed.

L.Pincherle

537.311.33 : 539.2

8140. DISLOCATION PLANES IN SEMICONDUCTORS. H.F.Mataré.

Scientia Electrica, Vol. 4, No. 4, 121-36 (1958).

A survey of the electrical properties associated with medium angle dislocation planes (grain boundaries with angle of misfit, θ, in the range $1^\circ < \theta < 25^\circ$). The electrical conductivity, photoelectric properties and band structure of these planes are discussed. Various devices are described making use of these properties: photoelectric devices, grain boundary transistors and grain boundary field-effect transistors.

B.T.M.Willis

537.311.33

8141. TRANSIENT RESPONSE OF GRAIN BOUNDARIES AND ITS APPLICATION FOR A NOVEL LIGHT SENSOR. R.K.Mueller.

J. appl. Phys., Vol. 30, No. 7, 1004-10 (July, 1959).

Grain boundaries in n-type germanium and silicon carry a negative surface charge and constitute a potential barrier for electrons. The height of this barrier can be increased by applying an electrical pulse across the boundary or decreased by injecting holes. The relaxation time with which the perturbed barrier returns to its equilibrium value is for sufficiently low temperatures very large compared to the time necessary to change the barrier height. A theory of the transient response of a grain boundary to a pulse is given for the low temperature region. It is shown that the application of a pulse of given height results in a barrier height ϕ_s which is practically independent of the barrier height ϕ_a prior to the pulse. The transient current, however, depends markedly on ϕ_a. A novel photosensor based on this phenomenon is described, and preliminary experimental results are reported.

537.311.33

8142. METHODS OF IMPROVING THE STABILITY OF THE HALL EFFECT PROBES. D.D.Voeĭkov.

Zh. tekh. Fiz., Vol. 28, No. 10, 2248-54 (1958). In Russian.

It was shown experimentally that non-homogeneity of the crystal lattice, rectification, and widely different Hall contact potentials are the main causes of thermal instability of the Hall effect probes. The rectification effects can be avoided by increasing the contact area which, however, lowers the sensitivity of the probe, so that rhodium plating of Ge parts is suggested as an alternative. Homogeneity of the crystal lattice can be ensured by soldering all the contacts simultaneously, and at the lowest possible temperatures.

M.H.Sloboda

537.311.33

8143. EFFECT OF VARIATIONS IN SURFACE POTENTIAL ON JUNCTION CHARACTERISTICS. J.H.Forster and H.S.Veloric.

J. appl. Phys., Vol. 30, No. 6, 906-14 (June, 1959).

A filamentary structure was used to compare the electrical properties of a germanium surface with those of an adjacent p—n junction intersecting the same surface. Surface charge is varied by field effect plates in the isolated portion of the filament and near the junction. An orderly relation can be found between surface potential variations and changes in the reverse currents across the junction. At low bias, the junction current varies with surface recombination velocity, and for bias near breakdown, the breakdown voltage varies with induced charge at the surface. For inverted surfaces, the low bias current varies rapidly as expected from channel length variations. With inverted surfaces, channel growth leads to large reverse current variations with surface potential, but breakdown voltage becomes independent of surface charge. These variations are considered in terms of simple theory, and device implications are discussed.

537.311.33 : 621.382

8144. HIGH-SPEED SWITCHING DIODES FROM PLASTICALLY DEFORMED GERMANIUM. G.L.Pearson and R.P.Riesz.

J. appl. Phys., Vol. 30, No. 3, 311-12 (March, 1959).

Diffused diodes, fabricated from plastically deformed germanium, were examined for high-speed switching response. The degradation of minority carrier lifetime caused by dislocations generated during plastic deformation greatly reduced the minority carrier storage effect and permitted fabrication of diodes with turnoff times of the order of 10^{-9} sec.

537.311.33 : 535.343

OPTICAL PROPERTIES OF Ge—Si ALLOYS UNDER HIGH PRESSURE. See Abstr. 7964

537.311.33 : 538.27 : 535.337

IMPURITY PHOTO-IONIZATION SPECTRUM OF SEMICONDUCTORS IN MAGNETIC FIELDS. See Abstr. 7946

537.311.33 : 548.5

VAPORIZATION—CRYSTALLIZATION METHOD FOR GROWING CdS SINGLE CRYSTALS. See Abstr. 7596

537.311.33 : 538.27

SPIN RESONANCE OF DEEP LEVEL IMPURITIES IN GERMANIUM AND SILICON. See Abstr. 7186

537.311.35 : 541.133

ELECTRICAL CONDUCTIVITY OF WATER AT HIGH SHOCK PRESSURES. See Abstr. 7575

537.312.5 : 621.383

8145. PHYSICS AND APPLICATIONS OF PHOTOCONDUCTIVITY. F.Stöckmann.

Z. angew. Phys., Vol. 11, No. 2, 68-80 (Feb., 1959). In German.

A review article. The kinetic and statistical models of photoconductivity are discussed. Photoresistive elements, photodiodes and transistors are described and brief accounts are given of the applications of photoconductors to xerography, vidicons and solid-state amplifiers.

J.Franks

537.312.5

8146. A DIAGRAM FOR THE DESCRIPTION OF PHOTOCONDUCTIVITY. H.J.Dirksen.

Appl. sci. Res. B, Vol. 7, No. 5, 400-8 (1959).

In this diagram (called E—B diagram), a discrete electron level of a photoconductor is represented by a point whose E-coordinate is a measure of the electron occupation in thermal equilibrium, and whose B-coordinate is a measure of the electron occupation under illumination. From the location of the different points in this E—B diagram the change of the electron distribution caused by illumination can be read for different temperatures. The two parts of the E—B diagram where this change is pronounced are called the inversion regions; a material, such as CdSe, that has its discrete levels in these regions will show a characteristic photoconductivity.

537.312.5

8147. THE PHOTOELECTRIC PROPERTIES OF POLYCRYSTALLINE AlSb. A.Abrahám.

Czech. J. Phys., Vol. 6, No. 6, 624-5 (Dec., 1956).

Freshly-cleaved samples of polycrystalline AlSb show a weak photoconductive effect, which decays after some days. The spectral sensitivity of the effect shows a peak corresponding to a forbidden energy band of about 1.4 eV at 300°K, with a temperature coefficient of about -4×10^{-4} eV deg K^{-1}, in agreement with values obtained from previous measurements of the optical constants. A photovoltaic effect may also be observed, showing a rather different spectral sensitivity. C.H.B.Mee

537.312.5 : 771.531

8148. ON PHOTOCONDUCTIVITY OF PHOTOGRAPHIC EMULSIONS. M.Závětová.

Czech. J. Phys., Vol. 7, No. 3, 327-34 (1957). In Russian.

The effect of illumination on the electrical conductivity of emulsion gels and dry, light-sensitive layers was investigated under various experimental conditions. The negative photo-effect observed in the emulsion gels is attributed to the recombination of photo-electrons with the Ag^- ions which constitute the current carriers in the absence of illumination. The positive photo-effect observed in the dry layers, in which the ionic conductivity is almost entirely suppressed, is taken to indicate that in this case the current is carried by photo-electrons. The mechanism of conduction postulated by the author is confirmed by the fact that, with increasing sensitivity of the layers, the magnitude of the photo-effect decreased. M.H.Sloboda

537.312.5

8149. PHOTOCONDUCTIVITY OF INDIGO.

A.T.Vartanyan and L.D.Rozenshtein.

Dokl. Akad. Nauk SSSR, Vol. 124, No. 2, 295-7 (1959). In Russian.

The photoconductivity of indigo, which was found to have the properties of a typical organic semiconductor, was studied for several vacuum deposited films. The dark conductivity increased with temperature, and a law was established for this variation in the range 40-110° C. The photocurrent, which satisfies Ohm's law up to fields of 5000 V/cm, was measured with variation in temperature and illumination intensity. Spectral curves are obtained giving the photoelectric sensitivity for layers of different thicknesses, both in vacuum and in an oxygen atmosphere. V.V.Zakharov

537.312.5

8150. PROPORTIONALITY BETWEEN PHOTOCONDUCTANCE AND TIME CONSTANT IN LEAD SULFIDE FILMS. H.E.Spencer.

J. appl. Phys., Vol. 30, No. 6, 927-9 (June, 1959).

Relative humidity variation, ageing, vacuum overcoating, and background light change the signal, the resistance, and the time constant of lead sulphide films at room temperature. Yet the relative change in photoconductance is proportional to the relative change in time constant. This result is taken as evidence that the time constant of photoconductivity is identical to the lifetime of the holes. It is shown that the ratio of signal to the product of resistance and time constant is useful in interpreting data taken on films whose properties are changed by ambient conditions.

537.312.5

8151. PHOTOCONDUCTIVITY IN CHEMICALLY DEPOSITED FILMS OF LEAD SELENIDE. D.H.Roberts and J.E.Baines.

J. Phys. Chem. Solids, Vol. 6, No. 2-3, 184-9 (Aug., 1958).

A method of preparing photoconductive films by chemical deposition is described. The results of measurements carried out on these films indicate that a variation of the hydrazine hydrate concentration used in the deposition leads to a variation in the thermal and optical activation energies from 0.27 to 0.60 eV. This is explained by postulating the existence of potential barriers in the film produced by variations in the Fermi energy. Finally, it is shown that these barriers also exist in some evaporated films and are the cause of the 1μ peak in the spectral response. One role of oxygen as a sensitizing agent is shown to be the filling of selenium vacancies and removal of these potential barriers. No evidence is found to support a theory of "barrier-modulated" photoconductivity, but rather one of "barrier-inhibited" conductivity.

537.312.5

8152. EDGE PHOTOCONDUCTIVITY OF CADMIUM SULPHIDE. M.Avinor.

Philips Res. Rep., Vol. 14, No. 3, 211-14 (June, 1959).

It is shown that the characteristic photoconductivity peak of single crystals at 515 mμ is not due to band—band transition. An additional photoconductivity peak is observed at 500 mμ by activation with silver in excess of coactivator. Superlinearity at room temperature was also observed.

537.312.5

8153. THE PHOTOCONDUCTIVITY OF ACTIVATED CADMIUM SULPHIDE LAYERS UNDER ELECTRON EXCITATION. F.Lappe.

Z. Phys., Vol. 154, No. 3, 267-85 (1959). In German.

Measurements were made of the reversible changes in conductivity of activated polycrystalline CdS layers irradiated by electrons with energies between 10 and 80 keV. The effects of the thickness of the CdS layers, the accelerating potential and the current density are discussed. One incident electron may give rise to up to 10^7 conduction electrons. From a comparison with the behaviour of the films irradiated with light, the energy required to excite a conduction electron by electron impact is estimated to be 9.3 eV. J.Franks

537.312.5 : 535.7

8154. THE EXCITATION SPECTRA OF PHOTOCONDUCTIVITY AND LUMINESCENCE FOR CdS CRYSTALS.

V.L.Broude, V.V.Eremenko and V.S.Medvedev.

Zh. tekh. Fiz., Vol. 28, No. 10, 2263-5 (1958). In Russian.

It was found possible to classify CdS crystals into those for which the excitation spectra at 20°K for green luminescence and photoconductivity in the region 20 500 - 21 500 cm^{-1} were very similar, and those for which they were not. The first group showed little fall-off in luminescence beyond 21 200 cm^{-1}, the second group showed a considerable amount. There was also a third group showing strong orange as well as green luminescence; some of these had high dark conductivity and a broad luminescence excitation band at 20 000 - 20 500 cm^{-1}, which suggested that there might be two types of orange centre. C.H.L.Goodman

537.312.5

8155. ON THE PROBLEM OF KINETICS OF THE VALVE-TYPE, P—N JUNCTION PHOTO-ELEMENTS.

S.M.Rÿvkin, N.B.Strokan and L.L.Makovskii.

Zh. tekh. Fiz., Vol. 28, No. 9, 1871-82 (1958). In Russian.

In an analytical study of the kinetics of a photodiode operating under the "valve" system conditions, the relaxation curves of the decaying current or e.m.f. were determined for various conditions. It was shown that when the conditions assumed by the author in his earlier work (Abstr. 8677 of 1957) i.e. infinite load resistance and low values of the capacitance currents are departed from, the relaxation curve is characterized by a portion which is determined by the recombination processes only, and from which the life-time of the non-equilibrium current carriers can be calculated. These conclusions were confirmed experimentally. M.H.Sloboda

537.312.5

8156. CURRENT—VOLTAGE CHARACTERISTICS OF DIFFUSED SILICON P—N JUNCTIONS. V.M.Tuchkevich and V.E.Chelnokov.

Zh. tekh. Fiz., Vol. 28, No. 10, 2115-23 (1958). In Russian.

Graphs of the relationship $\log I_\phi = f(V_0)$, where I_ϕ = the short-circuit photocurrent, plotted for Si photoelements operating at 20° and −196° C under the photodiode system conditions, consisted of three linear portions, each of which could be represented by

$$I_\phi = I_0(e^{\frac{qV_0}{\beta kT}} - 1).$$

The transition point between the first and the second branch corresponded to $V_0 \cong 0.1$ V, that between the second and third branches was at $V_0 \cong 0.4 - 0.5$ V. Coefficient β calculated for each branch from its slope was > 1, and its value increased with decreasing temperature. (Similar graphs were obtained for alloyed Ge photodiodes, except that the third branch was observed at low temperatures only). The current-voltage characteristics were studied at 30°-90° C. With the voltage U applied in the forward direction, the experimental graphs of I = f(U) agreed well with the formula

$$I = I_s e^{\frac{q - IR_p}{\beta kT}},$$

where I_s = saturation current, and R_p = the shunt resistance of the junction. When back voltage was applied, the I = f(U) graphs were characterized by the absence of the saturation region, i.e. R_p of the specimens decreased continuously with increasing U. The temperature dependence of the photovoltage and photocurrent were also studied. M.H.Sloboda

537.312.5 : 535.371

ENERGY TRANSFER IN ZnS : Cu : In PHOSPHORS. See Abstr. 7977

537.312.5 : 536.3.08

COOLED PHOTOCONDUCTIVE INFRARED DETECTORS. See Abstr. 8031

537.312.6

8157. AN ELECTRICAL RESISTANCE STUDY OF THE SYSTEM $(Cr_xMn_{1-x})Sb$. T.Suzuoka.
J. Phys. Soc. Japan, Vol. 12, No. 12, 1344-7 (Dec., 1957).

A study was made of the temperature dependence of electrical resistance in the system $(Cr_xMn_{1-x})Sb$, which forms a homogeneous nickel arsenide type solid solution of ferromagnetic MnSb and antiferromagnetic CrSb over the whole concentration range. It has been found that the resistance increases with rising temperature until it reaches a maximum at the Curie or the Néel point, and then it decreases. For the compounds with chromium concentration of $\sim 0.7 < x < \sim 0.8$ another type of anomaly, a small discontinuity of the resistance curve, was observed at low temperatures. It is concluded that this anomaly may be attributed to the magnetic transition between ferromagnetic and antiferromagnetic states, which was previously proposed to exist in this range of x.

537.312.62

8158. A NEW METHOD IN THE THEORY OF SUPERCONDUCTIVITY. N.N.Bogoljubov, V.V.Tolmachov and D.V.Širkov.
Fortschr. Phys., Vol. 6, No. 11-12, 605-82 (1958).

The method of canonical transformations proposed by Bogolyubov (Abstr. 2137 of 1947) in connection with a microscopic theory of superfluidity for Bose systems, is generalized here to Fermi systems, and forms the basis of a method for investigating the problem of superconductivity. Starting from Fröhlich's Hamiltonian, the energy of the superconducting ground state and the one-fermion and collective excitations corresponding to this state are obtained. It turns out that the final formulae for the ground state and one-fermion excitations recently obtained by Bardeen, Cooper and Schrieffer (Abstr. 1708 of 1958) are correct in the first approximation. The physical picture appears to be closer to the one proposed by Schafroth, Butler and Blatt (Abstr. 8637 of 1957). The effect on superconductivity of the Coulomb interaction between the electrons is analysed in detail. A criterion for the superfluidity of a Fermi system with a four-line vertex Hamiltonian is established. (Shortened translation of a monograph published in June 1958, by the U.S.S.R. Academy of Sciences).

537.312.62

8159. THE SUPERCONDUCTING ELLIPTICAL CYLINDER IN A LONGITUDINAL MAGNETIC FIELD. G.U.Schubert.
Z.Naturforsch., Vol. 13a, No. 12, 1021-5 (Dec., 1958). In German.

The London equations are solved for this geometry. The solution is discussed for a thin elliptical cylinder and for the limiting case of a parabolic cylinder. The latter leads to the result of Abstr. 7986 (1958). For transverse fields, see Abstr. 7042 (1958).
H.London

537.312.62

8160. THERMAL CONDUCTIVITY AND THE ATTENUATION OF SOUND IN SUPERCONDUCTORS. B.T.Geilikman and V.Z.Kresin.
Zh. eksper. teor. Fiz., Vol. 36, No. 3, 959-61 (March, 1959).
In Russian.

The authors take the theoretical expressions for x_e (electronic conductivity) and x_p (phonon conductivity) and compare their temperature dependence with the experimental data for the cases $x_e \ll x_p$, $x_e \gg x_p$, and $x_e \sim x_p$. Qualitative agreement is found in all cases. An expression derived for the sound attenuation coefficient coincides with that obtained by Bardeen, Cooper and Schrieffer.
M.G.Priestley

537.312.62

8161. QUASI-PERSISTENT CURRENTS IN RINGS COMPOSED OF SUPERCONDUCTING AND NON-SUPERCONDUCTING REGIONS.
H.J.Fink.
Canad. J. Phys., Vol. 37, No. 4, 474-84 (April, 1959).

A number of rings composed of a superconductor (Pb, In) apart from a small insert of normal metal (Cu) perpendicular to the current flow were investigated between 1.30° and 4.33°K for Pb—Cu and between 1.30° and 3.20°K for In—Cu. It was found that for samples with good electrical contact the decay of the magnetic field due to the current is exponential and that the effective resistance increased compared with the bulk resistance of Cu by approximately 2.1 for the Pb—Cu rings and by 18.5 for the In—Cu rings. Two different thicknesses of the Cu inserts (0.0125 and 0.0053 cm) were used and it was found that the resistivity of the thin Cu insert increased with respect to the thick foil by 16% for the Pb—Cu system and by 36% for the In—Cu system. Part of this relative increase can be explained as a size effect due to electron scattering in the Cu insert. The effective resistance of the Pb—Cu rings shows a maximum at approximately 3.4°K. The resistance of the In—Cu samples decreases by about 10% between 3.2° and 1.3°K. The resistivity of the Cu foil when measured separately was constant for the above temperature range. For samples with "poor" electrical contact (probably due to some copper oxide on the insert) two definite relaxation times were observed. For these samples the effective resistance was current and temperature dependent and it was decreasing for decreasing currents and decreasing temperatures. This can be explained in terms of a rectification effect of the two oxide layers on the insert. The decay of the magnetic field of the ring is consistent with the decay of a current in an L—R circuit.

537.312.62 : 534.23

8162. STUDY OF PHASE PROPAGATION IN SUPERCONDUCTING ALUMINUM BY ULTRASONIC ATTENUATION MEASUREMENTS.
K.L.Chopra and T.S.Hutchison.
Canad. J. Phys., Vol. 37, No. 5, 614-18 (May, 1959).

The phase propagation in superconducting aluminium has been studied by measuring the time rate of change of ultrasonic attenuation. The time taken for the destruction of the superconducting phase in a cylindrical specimen, by means of a magnetic field, H, greater than the critical field, H_c, is approximately proportional to $\{H/(H-H_c)\}$ in agreement with eddy-current theory. In the converse case, where the superconducting phase is restored by switching off the magnetic field $H\ (>H_c)$, the total time taken is nearly independent of the temperature (or H_c) as well as H. The superconducting phase grows at a non-uniform volume rate which is considerably less than the uniform rate of collapse.

537.312.62

8163. ON THE ABSENCE OF SUPERCONDUCTIVITY IN FERROMAGNETICS. S.V.Vonsovskii and M.S.Svirskii.
Dokl. Akad. Nauk SSSR, Vol. 122, No. 2, 204-7 (1958). In Russian.

The authors discuss the possibility of superconductivity in ferromagnetic metals on the basis of the new theory. In the normal state at T = 0, there are three regions in k-space: (I) containing equal numbers of electrons with spins of each orientation, (II) containing only s-electrons with spins $+\frac{1}{2}$, and (III) containing only holes. A modified canonical transformation is given which is applicable to this case. For superconductivity the condition $|\epsilon_k - \epsilon_{k+x}| < < \hbar\omega_x$ must be supplemented by the condition $\mu I_0 < \hbar\omega_x$, as the energy difference between regions I and III is $\sim \mu I_0$. For most ferromagnetics $\mu I_0 > \hbar\omega_x$ $(\mu \sim 1)$, and thus the superconducting state, is energetically unfavourable (I_0 is the s—d exchange integral). For small I_0, the presence of the region II reduces the transition temperature. It is concluded that, under special conditions, superconductivity may be found in some ferromagnetics.
M.G.Priestley

537.312.62 : 536.7

8164. THE THERMODYNAMICS OF SUPERCONDUCTORS.
D.N.Zubarev and Yu.A.Tserkovnikov.
Dokl. Akad. Nauk SSSR, Vol. 122, No. 6, 999-1002 (1958).
In Russian.

The thermodynamics of superconductors are considered using the Fröhlich Hamiltonian, in which the electron—phonon interaction is clearly taken into account. The Hamiltonian is rewritten using a canonical transformation of operators in which the coefficients are derived by taking into account the renormalization of the phonon—electron interaction. An expression for the jump in specific heat at the superconducting transition temperature is derived.
M.G.Priestley

537.312.62 : 536.7

8165. THE THERMODYNAMICS OF SUPERCONDUCTIVITY.
V.A.Moskalenko.
Dokl. Akad. Nauk SSSR, Vol. 123, No. 3, 433-6 (1958). In Russian.

A variational principle is used to derive the thermodynamic functions of a superconductor from the Fröhlich Hamiltonian. The partition function of a grand Gibbs ensemble is calculated and the expression for the thermodynamic potential is minimized. A model Hamiltonian is set up and its parameters are determined. An integral equation for the energy gap is obtained and a linearization of this leads to an equation for the transition temperature. An expression for the specific heat jump is also derived.
M.G.Priestley

537.312.62 : 536.212.2

PHONON THERMAL CONDUCTIVITY OF SUPERCONDUCTORS. See Abstr. 8025

537.312.8

8166. PHENOMENOLOGICAL THEORY OF ANISOTROPIC ISOTHERMAL GALVANOMAGNETIC EFFECTS.

L.P.Kao and E.Katz.

J. Phys. Chem. Solids, Vol. 6, No. 2-3, 223-35 (Aug., 1958).

The isothermal galvanomagnetic tensor components associated with the Hall effect and the magnetoresistanee effect are analysed for arbitrary orientation of the crystal axes in the sample, arbitrary orientation of the magnetic field B, and arbitrary crystal symmetry. The conductivity components in suitable co-ordinates are expanded in powers of the components of B. The coefficients are the galvanomagnetic material constants, called "brackets". By means of Onsager's relations, it is shown that the magnetoresistance effect is always even in B, whereas the Hall effect is odd in B only with special geometry. Further, the Hall effect is even or zero for some geometric and crystallographic conditions. The effects of the crystal symmetry on the brackets are covered by a theorem. The resultant dependencies between the brackets are tabulated completely for all powers of B for the crystal classes other than trigonal and hexagonal. For the latter, the bracket relations are given up to the sixth power of B. Formulae for the number of independent brackets up to any power of B are given for all crystal symmetries. The significance of the results obtained is pointed out.

537.312.8

8167. MAGNETO-RESISTANCE EFFECT IN THE REGION OF THE CURIE POINT. J.Pačes.

Czech. J. Phys., Vol. 7, No. 6, 729-43 (1957). In Russian.

The effect and the magnetization of Ni in the region of its Curie point were measured, also for sundry alloys with Si, Mn and Fe. The results are compared with what would be expected from the thermodynamics of second order phase transitions. For Ni the results are in good agreement with theory but not for the alloys. The author assumes that an alloy is made up of small volumes of alloys of varying composition, and different Curie points, the composition of the small volumes forming a Gaussian distribution about the mean value. The range of Curie points accounts for the rounded form of the various magnetic parameter curves in the region of the (mean) Curie point. By means of the above assumption the author is able to account satisfactorily for the behaviour of the magnetoresistance effect in the region of the Curie point for low concentration alloys.

C.R.S.Manders

537.312.8

8168. TRANSVERSE MAGNETORESISTANCE AND HALL EFFECT IN N-TYPE InSb. R.T.Bate, R.K.Willardson and A.C.Beer.

J. Phys. Chem. Solids, Vol. 9, No. 2, 119-28 (Feb., 1959).

Data on the transverse magnetoresistance and Hall effect are given for fixed temperatures between 50° and 200°K, covering the range from the weak-magnetic-field region to the strong-field quantum limit in InSb samples of high mobility and sufficient purity that classical statistics are applicable. At weak fields, results are in semiquantitative agreement with the predictions of theory based on a simple mixed-scattering mechanism and a spherical conduction band. At the highest fields, the transverse-magnetoresistance data approach the H/T behaviour expected on the basis of the quantum treatment of Argyres and Adams (Abstr. 2195 of 1957), and the result in the quantum limit for the purest specimen shows good agreement with the theory for reasonable values of the electron effective mass.

537.312.8

8169. HALL EFFECT IN COPPER AND Cu_3Au AT LOW TEMPERATURES. W.F.Love.

J. Phys. Chem. Solids, Vol. 9, No. 3-4, 281-4 (March, 1959).

The Hall coefficient in single crystals of copper and Cu_3Au in the ordered and disordered states has been measured at temperatures down to 4°K. No dependence of the Hall coefficient on orientation in copper has been found. In all cases the Hall coefficient is found to be appreciably temperature-dependent.

537.312.8

8170. ORDINARY HALL EFFECT IN Fe_3O_4 AND $(NiO)_{0.75}(FeO)_{0.25}(Fe_2O_3)$ AT ROOM TEMPERATURE. J.M.Lavine.

Phys. Rev., Vol. 114, No. 2, 482-8 (April 15, 1959).

Room temperature Hall measurements on a synthetic crystal of Fe_3O_4 and on a synthetic single crystal of $(NiO)_{0.75}(FeO)_{0.25}(Fe_2O_3)$ are reported. The thermoelectric power of the sample of Fe_3O_4 was also measured and verified that the sign of the charge carrier was negative. The ordinary Hall measurement of Fe_3O_4 suggests that the number of conduction electrons at room temperature is of the order of $3 \times 10^{21}/cm^3$, in rough agreement with Verwey's model. The ordinary Hall coefficient of $(NiO)_{0.75}(FeO)_{0.25}(Fe_2O_3)$ also suggests a large carrier concentration, of the order of $5 \times 10^{20}/cm^3$ at room temperature. The Hall mobility of Fe_3O_4 is the order of 0.5 cm²/V-sec and the Hall mobility of $(NiO)_{0.75}(FeO)_{0.25}(Fe_2O_3)$ is of the order of 0.05 cm²/V-sec. The conductivities of $(NiO)_{0.75}(FeO)_{0.25}(Fe_2O_3)$ and of a synthetic single crystal of $(NiO)_{0.56}(ZnO)_{0.14}(FeO)_{0.30}(Fe_2O_3)$ were measured and compared with the conductivity of Fe_3O_4 employing a simple model for the mobility and associating the activation energy obtained from resistivity data with the number of conduction electrons. The observed data are in good agreement with the simple model.

537.321

8171. CONTRIBUTION TO A GENERAL THEORY OF THERMOCOUPLES. A.H.Boerdijk.

J. appl. Phys., Vol. 30, No. 7, 1080-3 (July, 1959).

Application of thermodynamics of irreversible processes to a thermocouple of which (a) the bars have an arbitrary shape, (b) the properties of the materials are arbitrary functions of temperature, and (c) the composition is, under certain restrictions, inhomogeneous and anisotropic, leads through introduction of a single place coordinate to two nonlinear differential equations describing the stationary distribution of temperature and electrical potential. Output powers and efficiencies are expressed in terms of the temperature gradients in the bars. The maximal values of the efficiencies obtained by variation of the shape of the bars are independent of the shape. Upper bounds of the efficiencies attainable by stationary thermoelectric conversion are derived. If the shape of the bars is restricted to general cylinders and truncated wedges or cones the transient behaviour is described by two partial differential equations which contain two independent variables only. A periodic ripple in the electrical current has the same effect as a decrease of the electrical conductivities of the materials.

537.321

8172. InAs AND InSb AS THERMOELECTRIC MATERIALS.

R.Bowers, R.W.Ure, Jr, J.E.Bauerle and A.J.Cornish.

J. appl. Phys., Vol. 30, No. 6, 930-4 (June, 1959).

Measurements of the electrical conductivity, thermal conductivity, and Seebeck coefficient (thermoelectric power) of InSb and InAs made at high temperatures. The thermoelectric figure of merit $(S^2\sigma/\kappa)$ averaged 0.42×10^{-3} °K^{-1} between 100° and 500°C for InSb and 0.44×10^{-3} °K^{-1} between 500° and 750°C for InAs. Hence n-InA and InSb in series may be used to generate electrical power with an efficiency of about 6% when used in conjunction with p-type materials of similar characteristics. In neither InSb up to 500° nor InAs up to 800°C did the thermal conductivity show the large high-temperature anomaly previously reported in InSb.

537.322

8173. INFLUENCE OF THE GASEOUS ATMOSPHERE ON THE THERMO-E.M.F. OF A COUPLE CONSISTING OF SOLID Ag/THIN FILM Cu, JOINED TO PURE COPPER. H.Benel.

Rev. Fac. Sci. Univ. Istanbul C, Vol. 22, No. 3, 177-82 (July, 1957). In French.

As a sequel to the work on solid Ag/thin film Ag couples (Abstr. 3521 of 1959) equivalent measurements were made with thin film copper replacing the thin film of silver. The effects of hydrogen in the range 0-500 μ Hg were investigated. In general the therm e.m.f. was lower at higher hydrogen pressures. In some cases at the high pressure end of the range the thermal e.m.f. v. temperatur curve showed a maximum and led to a change of sign of thermo-e.m.f. at about 300°C.

C.A.Hogart

537.322 : 536.

8174. THERMOELECTROMOTIVE FORCE AND ADDITIONAL HEAT CONDUCTIVITY OF HETEROGENEOUS SYSTEMS.

S.V.Airapetyants and M.S.Bresler.

Zh. tekh. Fiz., Vol. 28, No. 9, 1935-8 (1958). In Russian.

In continuation of the work in which Airapetyants derived expressions for the coefficients of the thermo-e.m.f., and additional thermal conductivity of statistical mixtures (Abstr. 5934 of 1958), the authors calculated the coefficient of the thermo-e.m.f. and the increase of the thermal conductivity of a single crystal due to the Peltier effect. In addition, the coefficient of the thermo-e.m.f. of matrix system was determined for the cases corresponding to a small concentration of either phase. (A matrix system is a two-phase system, in which one of the phases is present in the form of isolated particles embedded in a continuous matrix formed by the other phase). M.H.Sloboda

537.322 : 539.2

8175. ANALYSIS OF PHONON-DRAG THERMOMAGNETIC EFFECTS IN N-TYPE GERMANIUM.

C.Herring, T.H.Geballe and J.E.Kunzler.
Bell. Syst. tech. J., Vol. 38, No. 3, 657-747 (May, 1959).

A study has been made of the Nernst effect and the variation of thermoelectric power with magnetic field for single-crystal samples of n-type germanium of various orientations and impurity concentrations, at fields up to 18 000 G and temperatures from 275° to 60° K and below. Except at the highest temperatures, both effects arise predominantly from that part of the thermoelectric power which is due to phonon drag. All observations can be quantitatively accounted for by theory. They yield information about the dependence of the relaxation times for phonon—phonon scattering on the frequency of the phonons, and establish with some certainty the conclusion that four-phonon collisions are much less important than three-phonon collisions in the pertinent range of temperatures and phonon frequencies. Auxiliary investigations have shown that the quantization of electron orbits in a magnetic field has only a small effect on transport properties when the cyclotron level spacing is less than thermal energy. The mean free path of electrons is shown to be energy-independent, as acoustic-scattering theory predicts. The absolute mobility can be predicted to within 10 per cent or better from data on the fractional changes of resistance with stress and magnetic field.

537.323

8176. $InAs_{1-x}P_x$ AS A THERMOELECTRIC MATERIAL.

R.Bowers, J.E.Bauerle and A.J.Cornish.
J. appl. Phys., Vol. 30, No. 7, 1050-4 (July, 1959).

Measurements of the electrical conductivity σ, the thermal conductivity K, and the Seebeck coefficient (thermoelectric power) α, of $InAs_{1-x}P_x$ were made at high temperatures with x varying from 0 to 0.4. Between 450° and 800°C, the average thermoelectric figure of merit ($z = \alpha^2\sigma/K$) increases moderately with x for small values of x, reaching a maximum near x = 0.1, and subsequently decreasing. Between 450° and 800°C, the average z for x = 0.1 is equal to $0.63 \times 10^{-3} (°K)^{-1}$, a 15% improvement over InAs. For the same figure of merit, the Seebeck coefficient and electric resistivity is higher in the ternary than in the binary InAs; this is advantageous for the design of thermoelectric devices. Previous values for the thermoelectric figure of merit of InAs are revised.

537.323 : 537.311.3

8177. THE THERMOELECTRIC, GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS OF MONOVALENT METALS.

M.Tsuji.
J. Phys. Soc. Japan, Vol. 13, No. 2, 133-48 (Feb., 1958).

A theory of the thermoelectric effects and transverse galvano- and thermomagnetic effects of monovalent metals is described on a model of general spherical energy band. Boltzmann's equation is solved by a variational method, and a formula of thermoelectric power is obtained which shows the possibility of positive thermoelectric power at high temperatures but not at low temperatures. The effect of the Umklapp processes on the time of relaxation at high temperatures is also investigated. The simple model can be used to derive the negative Ettingshausen and Ettingshausen—Nernst coefficients of noble metals at high temperatures.

537.323 : 537.311.3

8178. THE THERMOELECTRIC, GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS OF MONOVALENT METALS. II. THE THERMOELECTRIC POWER FOR ANISOTROPIC MEDIA.

M.Tsuji.
J. Phys. Soc. Japan, Vol. 13, No. 8, 818-27 (Aug., 1958).

In Pt I, it was shown that the thermoelectric power of monovalent metals at high temperatures is interpreted, at least semi-quantitatively, based on the spherical energy band model. It was shown that the energy model derived in Pt I (see preceding abstract) gives no possibility of a positive sign of the thermoelectric power of pure metals at low temperatures. The thermoelectric power at low temperatures is calculated for an arbitrarily anisotropic energy band. The results show that there is a possibility of obtaining positive thermoelectric power for pure metals at low temperatures if the shape of the energy surface is appropriate. The relation with the spherical band model used in Pt I is also discussed.

537.323 : 537.311.3

8179. THE THERMOELECTRIC, GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS OF MONOVALENT METALS. III. THE GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS FOR ANISOTROPIC MEDIA. M.Tsuji.

J. Phys. Soc. Japan, Vol. 13,No. 9, 979-86 (Sept., 1958).

A variational principle for the electron transport in a magnetic field is described, and the principle is applied to the calculation of the transverse effects of cubic metals in the transverse magnetic field by using an approximate trial function. The method gives exact solution for the spherical energy band model. For the anisotropic energy band, the method gives an approximate solution which coincides with the exact solution if the energy dependent relaxation time exists. Relations between the transverse galvanomagnetic and thermomagnetic coefficients, which hold for arbitrary scattering mechanism, are derived.

537.324

8180. REFRACTORY-METAL THERMOCOUPLES CONTAINING RHENIUM. C.T.Sims, G.B.Gaines and R.I.Jaffee.

Rev. sci. Instrum., Vol. 30, No. 3, 112-15 (Feb., 1959).

The thermoelectric force developed by the following junctions up to 2200°C was measured: Re v. W, Re v. Mo, Re v. W—30Re, and Re v. Mo—50Re. The thermoelectric force for W v. W—30 Re and Mo v. Mo—50 Re has been calculated. The Re v. W junction develops about 15 mV at 1000°C and may be usable up to 2600°C. Re v. Mo develops about 17 mV at 1000°C; the thermoelectric power is low above 1600°C. The outputs of Re v. W—30 Re and Re v. Mo—50Re couples are low and change signs at about 1200° and 1800°C, respectively. The calculated outputs of W v. W—30 Re and Mo v. Mo—50Re are high; the W v. W—30 Re output is nearly linear over a wide range in temperature, and the thermocouple should be useful to about 2600°C. All of these couples must be used in vacuum or in neutral or reducing atmospheres.

537.36 : 532.7

8181. THE ELECTROKINETICS OF LIQUID METALS. A.Klemm.

Z. Naturforsch., Vol. 13a, No. 12, 1039-43 (Dec., 1958).
In German.

Liquid mercury shows strong electro-osmosis towards the cathode in glass apparatus. The electrokinetic mobility is 2.5×10^{-3} cm^2/Vs. A value calculated by theory is ten times larger than this. The discrepancy is thought to be possibly due to the greater viscosity of the mercury at the walls modifying the electron drift. W.Good

537.36 : 532.612.4

ELECTROKINETIC POTENTIAL IN SURFACE TENSION PHENOMENA. See Abstr. 7835

537.363

8182. THE PRINCIPLES OF ELECTROPHORESIS.

R.Audubert and S.De Mende. Translated by A.J.Pomerans.
London: Hutchinson (1959) viii + 142 pp.

This is the first single volume in English to deal comprehensively with electrophoresis, and a very good survey of all aspects of the subject is presented. Following an elementary introduction into the general properties of electrolytes and colloidal systems and a theoretical treatment of the origin of electrokinetic potential, the authors deal with the determination of particle mobilities, a complete chapter being devoted to the experimental details and applications of the moving boundary method of Tiselius. Electrophoresis in a supporting medium is described and the techniques of paper electrophoresis reviewed at length. Finally, some applications of electrophoresis are described. The style is clear and concise and the text is extensively supported with well-chosen diagrams and tables. A full bibliography is given after each chapter and there are 16 plates. G.I.W.Llewelyn

ELECTRIC DISCHARGES

537.521.7

8183. A STUDY OF THE EROSIVE EFFECTS OF PULSED ELECTRIC DISCHARGES FOR WEAK CURRENTS. A.Prokeš.
Czech. J. Phys., Vol. 7, No. 3, 320-6 (1957). In Russian.

Describes experiments made with pulsed discharges (50-100 mA), duration 1-10 μsec. Cathode and anode spot craters for sparks in air and water were studied. Photographs are given, and the effects are discussed. J.D.Craggs

537.521.7

8184. ELECTRIC STRENGTH OF AROMATIC HYDROCARBON GASES. A.E.D.Heylen.
J. chem. Phys., Vol. 30, No. 4, 1106-7 (April, 1959).

See Abstr. 2265 (1957); 200 (1958). Continued work on correlation of electric strength, molecular structure and ultraviolet spectra is reported with Vs—pd measurements in benzene vapours. Mean collision cross-sections are given. A.E.D.Heylen

537.523.4

8185. SECONDARY MECHANISM IN TOWNSEND DISCHARGE DOMAIN. T.Mori.
E.T.J.Japan, Vol. 3, No. 1, 16-19 (March, 1957).

Time lags, i.e. statistical plus formative lags, were measured for air, pressures 2-20 mm Hg and gap lengths of 0.5 cm (presumably uniform field conditions). Analysis of the results gave formative times which are plotted for overvoltages varying up to about 20%. It is proposed that the operative secondary (γ) mechanism varies with overvoltage, and can be either a photon or positive ion induced effect. J.D.Craggs

537.525

8186. DEPENDENCE OF TEMPERATURE ON THE RADIUS OF THE POSITIVE COLUMN OF A LOW PRESSURE GLOW DISCHARGE. J.Kracík.
Czech. J. Phys., Vol. 7, No. 4, 444-54 (1957). In Russian.

Starting from the equation of continuity and energetic balance for the stationary case, the author shows that, contrary to previously held views, the variation of the temperature and concentration of electrons along the radius of the positive column of a low pressure glow discharge is, in fact, governed by the conditions at the discharge axis, and that these conditions depend on the source voltage, not on the discharge current. Approximate solutions of the equation are obtained which show that with increasing source voltage contraction of the discharge towards its axis occurs, when a constant, stabilizing resistance is employed. M.H.Sloboda

537.525

8187. JOSHI EFFECT IN HYDROGEN: OSCILLOGRAPHIC STUDIES AND A REVIEW OF THE MECHANISMS FOR PULSE PRODUCTION. D.P.Jatar.
Res. Bull. Saugar Univ. Phys. Soc., Vol. 2, No. 1-2, 1-38 (1957).

A very lengthy description of experiments on high voltage corona discharges in hydrogen (3-725 mm Hg) using external electrode ("ozoniser") tubes, and 50 c/s supply. The results are discussed in detail (70 refs.) in the light of other work on secondary processes at insulating surfaces in discharges. J.D.Craggs

537.525 : 539.1.07

8188. SIMILARITY THEOREM FOR AIR UNDER LOW FREQUENCY DISCHARGE USING A MAZE COUNTER. H.D.Sharma.
Res. Bull. Saugar Univ. Phys. Soc., Vol. 2, No. 1-2, 51-2 (1957).

Briefly describes experiments with external cathode Maze counters in which breakdown potentials were measured for various wire sizes and pressures. The results exhibit similarity relations, as demonstrated by Townsend for earlier and simpler discharge forms. J.D.Craggs

537.525.5

8189. PINCH EFFECT AND BREAKING OF AN ARC IN A CONSTRICTION. G.G.Timofeeva.
Zh. tekh. Fiz., Vol. 27, No. 11, 2669-71 (1957). In Russian. English translation in Soviet Physics — Technical Physics (New York), Vol. 2, No. 11, 2480-1 (Nov., 1957).

A low-pressure arc discharge in a mechanical constriction breaks if the current exceeds a value I given by $I = apS$, where a is an experimentally determined proportionality factor, p is the initial gas pressure, and S is the cross-sectional area of the constriction. For hydrogen $a = 4.2$ A cm^{-2}/micron of Hg. Under circumstances studied theoretically and experimentally, this break phenomenon is prevented by the intervention of the electromagnetic pinch effect. R.S.Pease

537.525.6

8190. MICRO-DISCHARGES AND THE PRE-DISCHARGE CURRENTS BETWEEN METAL ELECTRODES IN HIGH VACUUM. L.I.Pivovar and V.I.Gordienko.
Zh. tekh. Fiz., Vol. 28, No. 10, 2289-94 (1958). In Russian.

Cu and Pb electrodes (either both of the plane face type, or plane face cathode and hemispherical anode) were used in the experiments in which the effect of the electron component of the curren on the formation and growth of micro-discharges in a vacuum better than 3×10^{-6} mm Hg was studied with the aid of a transverse magnetic field. There was no field emission when the gap spacing exceeded 1.5 mm. Since the threshold voltage of the micro-discharges did not depend on the electron component of the current, it was concluded that they were caused by heavy particles. However, the growth of micro-discharges with the increasing voltage led to the formation of a continuous, pre-discharge current in which the electron component played the predominant part, and which culminated in a spark discharge through the vacuum gap. M.H.Sloboda

537.529 : 548.5

8191. SOME ASPECTS OF DENDRITE GROWTH ON ROCK SALT AT 200° AND 300° C. I.E.Balÿgin.
Zh. tekh. Fiz., Vol. 27, No. 6, 1229-32 (1957). In Russian. English translation in : Soviet Physics—Technical Physics (New York), Vol. 2, No. 6, 1121-4 (June, 1957).

The formation of dendrite filaments during partial breakdown was studied at relatively low temperatures and voltages, using various materials as cathodes and anodes. An explanation of the observed effects is given, in which the probability of electrons entering the crystal depends on the temperature and cathode materia The electrons form conducting Na ions, and the freed Cl ions drift towards the anode. Space charge effects account for the directional changes in the dendrites. R.C.Kell

X-RAYS

537.53

8192. USE OF SYNCHROTRON ORBIT-RADIATION IN X-RAY PHYSICS. L.G.Parratt.
Rev. sci. Instrum., Vol. 30, No. 4, 297-9 (April, 1959).

It is proposed to use the "very costly" orbit radiation for irradiation experiments, structure analysis, fluorescence spectroscopy, radiography etc. This radiation, which is by way of being a waste product of a synchrotron, is shown theoretically to be muc more intense for a 6 GeV machine than the X-rays obtained from conventional X-ray tubes. For the 1 GeV machine the orbit radiation is of about the same intensity as that from a conventional tube for wavelengths of about 1 A. For longer wavelengths the intensity advantage goes up rapidly until at 10 A it is about 10^4. J.Thewli

537.53

8193. ROTATING-ANODE X-RAY GENERATOR.
D.A.Davies, A.McL.Mathieson and G.M.Stiff.
Rev. sci. Instrum., Vol. 30, No. 6, 488-91 (June, 1959).

Construction of the rotating-anode X-ray generator was based on that of Taylor (1949), the main difference lying in the design of the anode and of the anode-cathode assembly. The anode is in the form of a flat disk, $\frac{7}{8}$ in. thick and 6 in. in diameter, with the focus on the periphery. The cathode assembly is extended to partly cove the anode. This combined anode-cathode assembly not only greatly reduces wall-heating due to stray electrons but also improves the electron-optical system. With zero-bias conditions, it has been fo possible with a silicated tungsten helix of outside diameter 0.065 in to concentrate 200 mA into a line focus 0.020×0.40 in. with nomin spread outside the focal area. The cooling system is cyclic.

537.531 : 535.

8194. INTENSITIES OF RADIATION FROM X-RAY TUBES AND THE EXCITATION OF FLUORESCENCE X-RAYS. N.Spielberg.
Philips Res. Rep., Vol. 14, No. 3, 215-36 (June, 1959).

The intensity of fluoresence X-rays is discussed in terms of t efficiency of conversion of given primary wavelengths to fluorescence radiation and the spectral distribution of the primary radiation from the X-ray tube. For single-element specimens and major constituents of multiple-element specimens in the geometries normally used in modern spectrochemical analysis, the conversion efficiency varies slowly with primary wavelength if the exciting wavelength is not too far from the specimen absorption edge. In these cases the fluorescence intensity is affected primarily by the radiation flux, expressed in photons/sec, from the exciting X-ray tube, and not so much by its wavelength distribution. For minor constituents of the specimen and/or when the exciting radiation is far from the specimen absorption edge, the conversion efficiency varies with the cube of the primary wavelength. The expected spectral intensity distribution, both in the characteristic and the continuous spectrum, from an X-ray tube target is discussed as a function of the target material. For the X-ray spectrochemical analysis of light elements (lighter than sulphur), the L-series radiation from a Mo or Ag target tube may lead to a large increase in fluorescence intensity. Experimental results confirming certain aspects of the theory are presented, and the need for further experiments, particularly with respect to soft X-rays, is pointed out.

537.531 : 535.3

8195. ABSORPTION COEFFICIENTS OF FINE STRUCTURES OF X-RAY ABSORPTION SPECTRA AT VARIOUS ABSORBER THICKNESS. K.Tsustumi, M.Obashi and M.Sawada.
J. Phys. Soc. Japan, Vol. 13, No. 1, 43-50 (Jan., 1958).

By using the North American Philips Diffraction Unit and Wide Range Goniometer modified to a tube spectrometer described by Coster and De Lang, the fine structures of X-ray K absorption spectra of copper in metallic copper, $CuCl_2 \cdot 2H_2O$, $CuSO_4 \cdot 5H_2O$ and cobalt in $CoCl_2 \cdot 6H_2O$ at various thickness were measured. The structures near the absorption edges are affected by the absorber thickness. The mass absorption coefficients of maximum absorption jumps become large with decreasing absorber thickness, and the small maximum and minimum near the absorption edges also become indistinct with increasing absorber thickness. The wavelengths of these structures are slightly affected. This is due to the finite resolving power of the spectrometer and the tail of the spectral window as mentioned by Parratt. In the high energy regions from the absorption edges the absorption coefficients are not affected by the absorber thickness.

537.531 : 535.3

8196. SOFT X-RAY ABSORPTION BY MANGANESE AND MANGANESE OXIDE. B.K.Agarwal and M.P.Givens.
J. Phys. Chem. Solids, Vol. 6, No. 2-3, 178-9 (Aug., 1958).

Experimental curves are given which show the absorption in the region between 45 and 60 eV. Both substances show an absorption edge near 50 eV. On the low-energy side of the edge, the oxide has a larger absorption coefficient than the metal.

537.531 : 535.341

8197. X-RAY ABSORPTION COEFFICIENTS AND GEOMETRICAL COLLIMATION OF THE BEAM.
L.G.Parratt, J.O.Porteus, H.W.Schnopper and T.Watanabe.
Rev. sci. Instrum., Vol. 30, No. 5, 344-7 (May, 1959).

In recent years, in order to achieve high angular collimation of an intense X-ray beam in a measurement of an absorption coefficient, most investigators have used the action of a high-resolving-power monochromator to provide the collimation. In this case, if the absorber exhibits small-angle scattering (including multiple scattering) of significant intensity in a scattering cone as large as a few seconds of arc, the value of the coefficient depends upon the absorber position with respect to the monochromator. A few measurements are reported with a two-crystal spectrometer to illustrate the points discussed.

537.531 : 535.43

8198. X-RAY SCATTERING FROM CCl_4. K.E.Banyard.
Acta cryst., Vol. 12, Pt 6, 472-5 (June, 1959).

By using a recent development for the calculation of the X-ray scattering from a gas of non-spherical molecules, the scattering factor for CCl_4 was computed. In this way it was possible to establish some comparison with experiment regarding the "valence" electron distribution in such a molecule when described by a Thomas—Fermi method. Further, a test was provided of the range of applicability of the general treatment used for evaluating the scattering factor.

537.531 : 535.43

8199. SMALL-ANGLE SCATTERING OF X-RAYS.
G.Wassberg and K.Siegbahn.
Ark. Fys., Vol. 14, Paper 1, 1-15 (1958).

Details of a hydrogen-filled low-angle camera with point focusing are given. A spherically bent quartz crystal gives a point-focused beam. Measurements have been made on latex particles up to 3400 A in diameter. A.R.Stokes

537.531 : 535.43

8200. CALCULATION OF THE INTENSITY OF SMALL-ANGLE X-RAY SCATTERING AT RELATIVELY LARGE SCATTERING ANGLES. P.W.Schmidt and R.Hight, Jr.
J. appl. Phys., Vol. 30, No. 6, 866-71 (June, 1959).

Since the small-angle X-ray scattering intensity can be expressed as a Fourier integral, the techniques of asymptotic expansion of Fourier integrals can be used to calculate the small-angle X-ray scattering at relatively large scattering angles. Some asymptotic expansion techniques which are often useful are described. The relation between the scattered intensity at relatively large angles and the characteristic function and its derivatives is discussed. The scattered intensity for both prolate and oblate ellipsoids of revolution is calculated to provide examples of asymptotic expansion methods, and the resulting expressions are evaluated numerically. The behaviour of the scattered intensity at relatively large scattering angles for platelet particles of negligible thickness is described.

537.531 : 548.732

SMALL ANGLE SCATTERING OF X-RAYS IN PERFECT CRYSTALS BY DOUBLE BRAGG REFLECTIONS. See Abstr. 7612

537.531 : 530.4.016.2

DOUBLE BRAGG X-RAY SCATTERING FROM COLD-WORKED METALS. See Abstr. 7554

537.531 : 548.733

MICROFOCUS X-RAY SOURCE. See Abstr. 7614

537.531 : 535.371.07

EFFICACY OF FLUORESCENT SCREENS FOR DIFFUSE X-RAYS. See Abstr. 7982

537.531.07

8201. SINGLE CRYSTAL CdS AS SOFT X-RAY DETECTOR.
B.Henry and H.Cole.
Rev. sci. Instrum., Vol. 30, No. 2, 90-2 (Feb., 1959).

ELECTRON EMISSION . ELECTRON BEAMS

537.533

8202. THE ELECTRON EMISSION OF X-RAY IRRADIATED FERRITES. A.Bohun and A.Bergstein.
Czech. J. Phys., Vol. 6, No. 6, 627 (Dec., 1956). In German.

The ferrite $Fe_2O_3.ZnO$ was prepared and the exo-electron emission versus temperature measured after X-ray irradiation (warming rate 1.9°/sec). The curve obtained shows in the higher temperature region (~ 600° K) a similarity to that for zinc oxide. Further investigations involving comparison with Fe_2O_3 results are indicated. G.F.J.Garlick

537.533 : 535.377

8203. THE ELECTRON EMISSION OF X-RAY EXCITED SULPHIDES. A.Bohun.
Czech. J. Phys., Vol. 6, No. 6, 628 (Dec., 1956). In German.

The relation between thermoluminescence and exo-electron emission versus temperature curves is examined for (Zn,Cd)S : Zn and ZnS : Ag phosphors. Results also show that the exo-electron emission, electrical conductivity and luminescence are all dependent on release of trapped electrons and recombination with luminescence centres. The conclusions favour the Schön—Klasens theoretical model rather than that due to Lambe and Click (Abstr. 4189 of 1957). G.F.J.Garlick

537.533

8204. ON A POSSIBLE EXPLANATION OF THE ELECTRON EMISSION FROM ALKALI HALIDE AND SILVER HALIDE CRYSTALS. M.Matyáš.
Czech. J. Phys., Vol. 7, No. 3, 277-81 (1957). In German.

Exo-electron emission characteristics are partly ascribed to

an electrical double layer formation on the crystal surfaces. This layer is related to an asymmetry of lattice defects near the surface.
G.F.J.Garlick

537.533 : 535.37 : 539.2

8205. THE INFLUENCE OF CHLORINE ON THE EXO-ELECTRON EMISSION AND LUMINESCENCE OF NaCl.

A.Bohun and J.Trnka.

Czech. J. Phys., Vol. 7, No. 6, 702-13 (1957). In German.

Comparison of "glow curves" for luminescence and exo-electron emission suggests the presence of neutral chlorine in excess in the NaCl crystals examined. Results point to the possibility of interaction between V and F centres and to the possibility of A centres.
G.F.J.Garlick

537.533

8206. A STUDY OF THE INTEGRAL AND LOCAL SENSITIVITIES OF PHOTOCATHODES, AND OF THEIR EFFECT ON THE CHARACTERISTICS OF THE SCINTILLATION DETECTOR PLATEAU.

J.Šilar and O.Nováková.

Czech. J. Phys., Vol. 7. No. 5, 614-23 (1957). In Russian.

The characteristics of a large number of photocathodes used in various types of photomultipliers were investigated. The following was found: (i) Photocathodes characterized by the same integral sensitivity had widely different blue sensitivities; (ii) As a rule, the sensitivity of a photocathode varied considerably over its area; (iii) The distribution of the local sensitivity did not depend on the wavelength, at least in the region of the radiation spectrum of the more common luminescent substances; (iv) In certain cases, the distribution of sensitivity varied with time; (v) The length of the plateau depended on the blue sensitivity, while its slope was determined by both the homogeneity and blue sensitivity of the photocathode.
M.H.Sloboda

537.533

8207. THE MODIFICATION OF A METALLIC SURFACE AFTER ELECTRON EMISSION UNDER ATMOSPHERIC CONDITIONS.

A.Hrbek and L.Vlasáková.

Czech. J. Phys., Vol. 7, No. 5, 626-7 (1957). In German.

The photoelectric emission under atmospheric conditions from thin films of Al evaporated on to glass in vacuo was studied. The time variation of photoemission showed an increase over 2-3 orders of magnitude during the first seconds of illumination, tending towards a saturation value. Continued illumination over a period of about 10 min caused a further increase in photoemission over about 1 order of magnitude. The initial increase was shown to be accompanied by the formation of a thin surface layer of aluminium oxide. Emission and oxide formation were most marked for irradiation by photons of energy about 3.2 eV. A hypothesis is proposed which assumes the existence of colour centres which suffer photoionization on initial illumination. A number of the electrons so liberated form oxygen ions with neighbouring oxygen atoms; these ions react with the metallic ions to form the oxide layer, and impurity levels in the oxide cause the second increase in photoemission.
C.H.B.Mee

537.533

8208. ON THE PHOTOTUBES SENSITIVE TO THE WIDE SPECTRAL REGION.

M.Sugawara.

J. Phys. Soc. Japan, Vol. 12, No. 11, 1282-90 (Nov., 1957).

Phototubes were constructed which are sensitive to light in the spectral region from ultraviolet to near infrared, and which are suitable for spectral photometry throughout this spectral region. The light transmission and photoelectric yields of the thin photocathode films such as antimony—caesium, silver—caesium oxide and bismuth—caesium oxide were investigated.

537.533

8209. THE SECONDARY EMISSION OF BORIDE CATHODES LaB$_6$ AND (LaLi)B$_6$.

R.Lenk.

Czech. J. Phys., Vol. 6, No. 6, 625-6 (Dec., 1956). In German.

Lanthanum boride LaB$_6$ gave an emission maximum of just below unity at 1 kV. The emission was independent of activation. (LaLi)B$_6$ gave a slightly higher maximum at about 400 V. In this case, activation increased δ at low voltages but the decline after the maximum is more rapid for the activated material.
A.H.W.Beck

537.533

8210. SOME FACTORS AFFECTING THE DECAY OF SECONDARY ELECTRON EMISSION OF SILVER—MAGNESIUM ALLOYS.

M.Hirashima and S.Miyashiro.

J. Phys. Soc. Japan, Vol. 12, No. 7, 770-7 (July, 1957).

The secondary emission yield is observed to decay very rapidly under electron bombardment especially during the exhaust process using an oil diffusion pump. In this paper, factors affecting the decay, a method of making the decayed yield recover, and effects of various gases and vapours on the yield are discussed. A major cause of the secondary yield decay is attributed to the deposition of amorphous carbon, which is produced on the dynode surface through the decomposition of hydrocarbon or carbon-containing gases by the electron beam. Heating the contaminated dynode at high temperatures in an oxygen atmosphere results in a recovery of the yield. Keeping the dynode at high temperatures during electron bombardment is effective in bringing about a marked decrease in the decay. From the data on the temperature dependence of the decay, the heat of adsorption of a gas which is considered to be the source of contamination is calculated to be about 1.6 kcal/mole. N$_2$, CO and CO$_2$ do not exert any harmful effects upon activated dynodes, while H$_2$ exerts somewhat harmful effects, and, particularly, electric discharge in H$_2$ should be avoided. The most unfavourable gas is the grease vapour. The process of contamination is briefly discussed.

537.533

8211. A THEORY OF SECONDARY ELECTRON EMISSION FROM METALS.

H.Stolz and H.W.Streitwolf.

Z. Naturforsch., Vol. 13a, No. 12, 1100-1 (Dec., 1958). In German.

A short note giving an analysis using Diracs perturbation theory. The theory predicts an energy spectrum of secondary electrons which is in good agreement with experiment but the angular distribution of energy differs characteristically from the results of Jonker (Abstr. 7963 of 1957) in that with increasing energy it predicts more electrons with a large exit angle.
C.G.Morgan

537.533

8212. MEASUREMENT OF THE ANGULAR DISTRIBUTION OF ELECTRONS EJECTED FROM TUNGSTEN BY HELIUM IONS.

R.C.Abbott and H.W.Berry.

J. appl. Phys., Vol. 30, No. 6, 871-3 (June, 1959).

Rotating collector measurements, made at a pressure of 10^{-5} mm Hg, yielded cosine distributions for all experimental conditions. Data were obtained for gas-covered and partly gas-covered target surfaces, for several beam incidence angles, and for ion energies of 40, 400, and 825 eV. It is postulated that the identical cosine distributions observed for both kinetic and potential ejection are caused by the existence of isotropic angular distributions for both mechanisms within the metal. A general expression is given for the angula distribution of emission from an arbitrarily shaped surface. This expression is a function of the fundamental angular distribution associated with a single element of area on that surface and the orientation distribution of the elements of area.

537.533

8213. PARAXIAL FORMULATION OF THE EQUATIONS OF ELECTROSTATIC SPACE-CHARGE FLOW.

P.T.Kirstein.

J. appl. Phys., Vol. 30, No. 7, 967-75 (July, 1959).

The equations of electrostatic irrotational space-charge flow ar set up in a paraxial manner. Given an arbitrary trajectory, and the potential distribution along that trajectory, the variation of such qua tities as potential and beam convergence in the vicinity of the specified trajectory are investigated. A detailed analysis is carried out for beams from a space-charge-limited cathode in the form of a cone. The agreement between the paraxial theory and the exact theory for particular beams is investigated. Numerical results are presented for beams from a conical cathode which predict beams with a microperveance of about 15 and a very large area convergence. It is felt that by use of this method much higher perveances and beam convergences could be obtained for hollow and sheet beam than have heretofore been possible.

537.533 : 621.385.

8214. A COMPARATIVE STUDY OF CYLINDRICAL, ELLIPTICAL AND PRISMATIC FORMS OF ELECTRONIC TUBES.

A.I.Vishnievsky, S.Sampath and C.S.Upadhyay.

J. Indian Inst. Sci. B, Vol. 41, No. 1, 1-6 (Jan., 1959).

For previous study, see ibid. Vol. 40, No. 4 (1958). In the present paper, the study is extended to include the condition of space-charge saturation in the device. To facilitate analysis, a third form of tube is considered, in addition to the cylindrical and prismatic forms. This consists of a flat strip cathode surrounded by an anode of thin elliptical cross-section. By the method of conformal transformation, equivalence is set up between a diode havin the elliptical shape and a cylindrical diode. The equivalent structu possessing the same electrostatic capacitance per unit length and giving approximately the same space-charge saturated current are then compared as to their design parameters. The thin elliptical diode is found to have a decisively better design parameter than the equivalent cylindrical diode. A further comparison of equivalent elliptical and prismatic diodes shows the latter to be slightly superior. The elliptical form helps to set up equivalence between the prismatic and cylindrical forms of diodes. From the point of view of physical construction, it is likely to provide a more stable structure than the prismatic shape.

537.533 : 621.385.833

8215. AN EXPERIMENTAL STUDY OF INTERCEPTION NOISE IN ELECTRON STREAMS AT MICROWAVE FREQUENCIES.

B.A.McIntosh.

Canad. J. Phys., Vol. 37, No. 3, 285-99 (March, 1959).

The noise added to an electron stream by the interception of a fraction of the current has been studied experimentally at a frequency of 3 kMc/s. The electron beam was produced in a demountable vacuum system by a parallel-flow Pierce gun in a confining magnetic field. A series of circular apertures and mesh grids on a plate capable of being moved within the vacuum chamber allowed the interception of various fractions of the total beam current. The excess noise caused by interception was measured at the anode of the electron gun and at various points in a drift region. Interception noise caused by mesh grids was found to be of much greater magnitude than that caused by circular apertures. The absolute level of the excess noise and its variation with the strength of the confining magnetic field were found to be in reasonable agreement with existing theory as modified by the author. It was shown that current interception excites a standing wave of noise along the electron beam in the drift region. Measurements made on a temperature-limited electron beam have shown that interception noise can arise in a region where noise smoothing is a consequence of precesses external to the electron gun.

537.533

8216. AXIALLY SYMMETRIC ELECTRON BEAMS OF UNIFORM AXIAL VELOCITY. E.J.Cook.

J. appl. Phys., Vol. 30, No. 6, 860-5 (June, 1959).

Since the initial work of Brillouin, interest in long, dense electron beams with a uniform velocity profile has increased steadily. In this paper, the general member of this class of beams is derived. Various special cases become the equilibrium systems of current interest. In addition to these known systems, the analysis leads to new possibilities. One of these is of particular interest in that it is the first of this group of beams in which the axial velocity is important to the balance of forces on the electrons. The new beam has properties ideal for M-type interaction and should be of considerable future importance.

537.533

8217. SOME CHARACTERISTICS OF A MAGNETICALLY FOCUSED ELECTRON BEAM. G.R.Brewer.

J. appl. Phys., Vol. 30, No. 7, 1022-38 (July, 1959).

The detailed behaviour of a solid cylindrical electron beam focused by a uniform magnetic field (Brillouin flow) was studied experimentally. These studies included the influence of the optics of the electron gun on the beam-focusing characteristics, the effects of transverse "thermal" velocities, the change in the internal beam dynamics with increasing values of magnetic focusing field, etc. A simple model of the beam is used to explain certain of the observed characteristics. It is found that an optically good electron gun will produce a focused beam which closely resembles the theoretical Brillouin-flow model. A brief analysis of the electron motion in a magnetically focused beam is given.

537.533 : 537.54

8218. ELECTRON-OPTICAL SYSTEM OF ELECTRODES FOR THE INJECTORS FOR ELECTRON ACCELERATORS.

I.M.Samoilov.

Pribory i Tekh. eksper., 1959, No. 1, 24-7 (Jan.-Feb.). In Russian.

An electrode system was designed for the injectors of betatrons and synchrotrons. Several forms of electrode were examined, using both spiral and strip cathodes. Detailed curves are given of beam angular-distribution for several sets of electrode dimensions. Emission current densities up to 10 A/cm^2 could be obtained with anode voltages not greater than 15 kV. J.H.Fremlin

537.533

8219. EXPERIMENTAL DEMONSTRATION OF ELECTRON-OPTICAL REGENERATIVE IMAGE AMPLIFICATION.

L.W.Jones and M.L.Perl.

Rev. sci. Instrum., Vol. 29, No. 5, 441-2 (May, 1958).

Briefly describes an optical feedback system in which the light from an image intensifier screen is fed back via a Schmidt plate system to the photo-sensitive surface. It is thought that a gain of 10^6 would be feasible after further development.

A.E.I.Research Laboratory

537.533

8220. A STUDY OF ELECTRON BEAM FILTER.

E.Sugata, S.Kaneda, T.Kishi and H.Hayashi.

Technol. Rep. Osaka Univ., Vol. 7, 37-46 (March, 1957).

A 90° magnetic electron spectrometer is described for producing a monochromatic electron beam from the output of a linear accelerator. A cylindrical (line focus) lens is used to convert the line image of the spectrometer into a spot suitable for use with the electron microscope. An analysis of the electron optical properties of the system is given. T.Mulvey

537.533

8221. A FILTER-TYPE ANALYSER USING AN ELECTRON OPTICAL SYSTEM AND ITS APPLICATION TO ELECTRON DIFFRACTION. F.Catalina.

An. Real Soc. Espan. Fis. Quim., Vol. 55(A), No. 1-2, 25-32 (Jan.-Feb., 1959). In Spanish.

Describes an electrostatic filter lens of the Boersch type (Abstr. 5037 of 1950). This consists of a negatively charged mesh placed between specimen and lens in a diffraction camera so as to remove inelastically scattered electrons from the image plane. The improved contrast obtainable with a filter is illustrated by diffraction patterns from a gold film. A.E.I. Research Laboratory

537.533

8222. MAGNETIC ELECTRON LENSES.

P.Durandeau and C.Fert.

Rev. Opt., Vol. 36, No. 5, 205-34 (May, 1957). In French.

Comprehensive survey of the rules of design for electron lenses for electron microscopes and similar instruments.

T.Mulvey

537.533

8223. AN ELECTRON MICROSCOPE WITH UNIVERSAL APPLICABILITY FOR ELECTRON DIFFRACTION. H.Bethge.

Optik, Vol. 16, No. 1, 35-42 (Jan., 1959). In German.

An electron microscope has been built, especially for crystal physics research, embodying three electrostatic lenses and a weak magnetic intermediate lens. The electrostatic lenses by themselves give fixed magnifications of 1800, 5000 and 12 000 times; with the magnetic lens intermediate values can be obtained, and a low magnification range from 200 to 1800 times. The magnetic lens is also used for electron diffraction. A special form of filament holder is described. A Steigerwald gun and a Rang stigmator are employed. The high tension supply is continuously variable up to 60 kV. The best resolution so far obtained is about 40 A. V.E.Cosslett

537.533 : 621.385.833

8224. UNUSUALLY HIGHLY BIASED GUN ON THE ELECTRON MICROSCOPE. F.W.Bishop.

Rev. sci. Instrum., Vol. 30, No. 6, 468-9 (June, 1959).

A self-biasing arrangement is described whereby the beam current of the electron microscope is decreased to less than 5 μA. This reduction of beam current reduces the contamination rate and the heating of the specimen and at the same time improves the illumination. A further combination wherein the bias can be adjusted from the control panel is described. The smaller aperture in the condenser system which is made possible by this system reduces the angular aperture of illumination and increases the depth of focus and resolution.

537.533

8225. REFLECTION OF ELECTRONS AND SECONDARY-ELECTRON EMISSION FROM METAL SURFACES IN THE REGION OF LOW PRIMARY ENERGIES. I.

I.M.Bronshteĭn and V.V.Roshchin.

Zh. tekh. Fiz., Vol. 28, No. 10, 2200-8 (1958). In Russian.

Nickel targets subjected to various degassing treatments were bombarded by electrons with energy E_p = 0.2-30 eV, and the variation of the coefficients of electron reflection r and secondary-electron emission σ with varying E_p was studied. The relationships $\sigma = f(\pm V_k)$ where V_k = collector potential, $(\sigma - r) = f(E_p)$, and $d\sigma/dE_v = f(E_v)$ where E_v = energy of the secondary electrons, were also determined. At $E_p \leq 5$ eV the secondary electrons were, in fact, elastically reflected primary electrons. The results, reproduced graphically, confirmed the general conclusions reached by other investigators. M.H.Sloboda

537.533

8226. REFLECTION OF ELECTRONS AND SECONDARY ELECTRON EMISSION FROM METAL SURFACES IN THE REGION OF LOW PRIMARY ENERGIES. II.
I.M.Bronshteĭn and V.V.Roshchin.
Zh. tekh. Fiz., Vol. 28, No. 11, 2476-86 (1958). In Russian.

The apparatus and techniques previously used on Ni (see preceding abstract) were applied to Pt, Cu, Ag, Au, and Al. Graphs are given of the reflection coefficients of primaries and the coefficients of secondary electron emission as a function of primary electron energy (up to 30 eV). It is suggested that maxima and minima on the curves may be connected with similar maxima and minima in the density of electron states in the metals as a function of energy. K.F.Hulme

537.533 : 539.27

8227. NEW ELECTRON DIFFRACTION APPARATUS FOR CONTINUOUS RECORDING. R.Thun.
Rev. sci. Instrum., Vol. 30, No. 6, 399-407 (June, 1959).

A new electron diffraction device is described which is especially suited for the investigation of diffusion problems, phase transitions, and reactions of solids with gases or other solids. It is equipped with a continuously recording camera where a 4 × 10 in. photoplate passes underneath a narrow slit exposed to the diffraction cone. The resulting photograph shows parallel diffraction lines instead of the usual Debye—Scherrer rings and gives a gapless picture of the occurring structural changes which are easy to evaluate. If the sample is heated according to a known temperature-time function, the temperature-structure dependence may be recorded, and by moving the sample synchronously with the plate through the electron beam, one may record the geometrical distribution of different structures in an inhomogeneous sample. The latter method is especially suited for a rapid investigation of unknown binary or multicomponent phase diagrams. The device includes the following special features: deposition of the sample containing up to 3 different components by evaporation inside the specimen chamber, an attachment for monitoring the sample reflectance during runs, a rotating shutter producing wedge-shaped sample layers, and a heatable specimen holder for use in transmission as well as in reflection. A few examples are given showing some applications of the described electron diffraction unit.

537.533 : 548.74

SCATTERING OF ELECTRONS BY ATOMS AND CRYSTALS. I. A NEW THEORETICAL APPROACH. See Abstr. 7655

537.533

8228. CALCULATIONS ON THE EXTINCTION OF MONOENERGETIC ELECTRON BEAMS IN LAYERS OF MATTER. Ya.Chudars.
Latv. PSR Zinat. Akad. Vestis, 1957, No. 3(116), 111-22. In Russian.

The effect is first calculated for various materials and energies by using a previously deduced approximation formula. A correction is then applied to allow for single collisions, and another, taking into account the repeated backward diffusion of electrons. The final results agree well with experimental findings. P.Roman

ION EMISSION . ION BEAMS

537.534

8229. IONIZATION OF LITHIUM ON TUNGSTEN. A.M.Romanov.
Zh. tekh. Fiz., Vol. 27, No. 6, 1233-9 (June, 1957). In Russian.
English translation in : Soviet Physics — Technical Physics (New York), Vol. 2, No. 6, 1125-30 (June, 1957).

Experimental data are given on the ionization of lithium on hot tungsten wires. The results are shown to be consistent with the view that the tungsten surface is non-uniform and that patches with varying work functions exist. Agreement is shown between experimental ion current curves and those computed for patchy surfaces with an assumed range of work functions. The results are compared with similar data for sodium on tungsten. W.G.Townsend

537.534

8230. DESIGN AND PERFORMANCE OF A HOT CATHODE MAGNETICALLY COLLIMATED ARC DISCHARGE ION SOURCE.
M.Abele and W.Meckbach.
Rev. sci. Instrum., Vol. 30, No. 5, 335-8 (May, 1959).

The discharge is collimated in an axial magnetic field and the ion beam is extracted axially. The maximum total ion current of the source, tested with hydrogen, is 42 mA. The extraction system allows focusing of almost 100% of this current. The limiting factor of the maximum ion current is analysed. Although strong arc discharges could allow the extraction of higher ion currents, space charge spreading causes the ion beam to hit the front surface of the extracting electrode. Secondary electrons, released there, are focused back into the arc chamber producing instabilities of the source. A convenient means of regulation or modulation of the beam current is described. A magnetic analysis of the extracted beam shows about 34% atomic ion current.

537.534

8231. PRECISION INTEGRATOR FOR ION BEAMS.
F.J.Lynch and A.Langsdorf, Jr.
Rev. sci. Instrum., Vol. 30, No. 4, 276-9 (April, 1959).

The integrator consists of a circuit which operates relays to turn off data-storage devices, timers, etc., when the charge conducted by an ion beam reaches a specified quantity. A vibrating-reed electrometer (without feedback) senses when the potential drop across a capacitor into which the beam current flows becomes equal to the potential of several standard cells in series. Errors in sensing the potential are less than 0.001%, and the over-all time delay of the relay operation is about 15 msec. The major sources of error are associated with soakage and changes in capacitance with temperature, less than 0.05% and about −0.01% per °C, respectively. It should be feasible to attain a considerable reduction in all the errors of integration caused by these known sources of error.

537.534

8232. ION OPTICS FOR THE V-TYPE SURFACE IONIZATION FILAMENT USED IN MASS SPECTROMETRY. L.A.Dietz.
Rev. sci. Instrum., Vol. 30, No. 4, 235-41 (April, 1959).

A field-plotting and ray-tracing technique based on electron-optical methods is developed for first-order ion optics of slit lenses and is applied to a Nier-type thick lens. A resistance paper analogu gives the distribution of electrostatic potential. Maxwellian velociti of ions emitted from the filament and lens thickness affect ion trajectories, which are calculated to a few percent accuracy by a simpl approximation technique. Paraxial ray paths are shown and the ion-focusing action of the single filament is described. Optimum detect ability, 100 counts of the smallest isotope, is 5×10^{-15} g for uraniu and 2×10^{-15} g for plutonium. Ionization at moderate temperatures improves transmission and avoids background impurities which appear at temperatures above 2000° C. Independent electrostatic focusing in the z direction improves transmission through the analyzer.

537.53

8233. USE OF MOVING HIGH-FREQUENCY POTENTIAL WELL FOR THE ACCELERATION OF CHARGED PARTICLES.
A.V.Gaponov and M.A.Miller.
Zh. eksper. teor. Fiz., Vol. 34, No. 3, 751-2 (March, 1958). In Russian. English translation in: Soviet Physics — JETP (New York), Vol. 34(7), No.3, 515-16 (Sept., 1958).

It is possible to localize charged particles of any sign in poten tial wells corresponding to absolute minima in the potential of high frequency electromagnetic fields. By varying the oscillator frequency it is possible to produce accelerated motion of the potential wells, and thus of the charged particles. Such a device could be used to acceleraie "quasi-neutral" plasma bunches. A.E.I. Research Laborato

537.5

8234. THE CURVATURES OF DIRECTION — AND ENERGY-FOCUSING CURVES IN DOUBLE-FOCUSING MASS-SPECTROGRAPHS. H.Liebl.
Optik, Vol. 16, No. 2, 108-112 (Feb., 1959). In German.

An earlier paper (Abstr. 8820 of 1958) dealt with the angle between these curves at the point of double focusing; formulae for their curvature at that point are derived, and values are given for existing and proposed instruments. B.Meltz

537.534

8235. A MINIATURE RADIOFREQUENCY MASS-SPECTROMETER. E.F.Doil'nitsin, A.I.Trubetskoi and M.Ya.Shcherbakova.
Pribory i Tekh. eksper., 1959, No. 2, 81-2 (March-April).
In Russian.

The instrument is sealed into a glass bulb with a normal miniature moulded glass base, overall dimensions being 100 mm × 23 mm diameter. It operates at about 10 Mc/s and spectra are shown for 10^{-3} and 10^{-4} mm. Very fine grids (11μ wire with 75μ spacing) are used to define the drift space (1 mm) well. Some detailed dimensions are given but extensive references are made to previous Russian work. J.H.Fremlin

537.534

8236. COMPUTATION OF A DOUBLE-FOCUSING, STIGMATIC MASS SPECTROMETER. H.Ewald, H.Liebl and G.Sauermann.
Z. Naturforsch., Vol. 14a, No. 2, 129-37 (Feb., 1959). In German.

Describes the computation of the aberrations. The resolving power is 25 000. A toroidal electrostatic deflector system is used instead of the usual cylindrical arrangement. Specially shaped exit slits are employed to minimize aberrations. T.Mulvey

537.534

8237. CONSTRUCTION AND TESTING OF A DOUBLE-FOCUSING STIGMATIC MASS SPECTROMETER.
G.Sauermann and H.Ewald.
Z. Naturforsch., Vol. 14a, No. 2, 137-41 (Feb., 1959). In German.

Describes the method of construction of the spectrometer referred to in the preceding abstract. The machining and adjustment of the toroidal deflecting section receives special mention. Spectra are shown indicating a resolving power of 25 000 with a fairly short exposure time. T.Mulvey

PARTICLE ACCELERATORS

537.54

8238. RESOLUTION OF ACCELERATOR MAGNETIC ANALYZING SYSTEMS. B.L.Cohen.
Rev. sci. Instrum., Vol. 30, No. 6, 415-18 (June, 1959).

In analysing systems consisting of a beam analysing system and a reaction product analysing system, the total resolution of the system may be made, to first order, independent of target thickness or independent of the width of the beam on the target, by proper choice of target orientation angle. By proper choice of geometry, the two may be accomplished simultaneously for a given nuclear reaction, and suitable compromises give reasonably good results for a large variety of applications. In most cases, taking advantage of these effects allows an order of magnitude increase in intensity without affecting the resolution.

537.54

8239. MOMENTUM KICKS FOR PARTICLES CROSSING A GAP AT AN ANGLE. J.Van Bladel.
Rev. sci. Instrum., Vol. 30, No. 4, 265-8 (April, 1959).

Formulae are derived for the longitudinal and lateral momentum kicks to which a particle is subjected upon crossing an accelerating gap. The angle ϵ between the particle's trajectory and the axis of the accelerator tube is assumed to be small, and terms of higher order than the first in ϵ are neglected.

537.54 : 537.533

ELECTRON-OPTICAL SYSTEM OF ELECTRODES FOR THE INJECTORS FOR ELECTRON ACCELERATORS. See Abstr. 8218

537.54

8240. 22-MeV ELECTRON LINEAR ACCELERATOR.
N.A.Austin and S.C.Fultz.
Rev. sci. Instrum., Vol. 30, No. 4, 284-9 (April, 1959).

An accelerator of the travelling-wave type, with several unique features, is described. The features include the combination of an r.f. driven prebuncher cavity and a buncher of a new type in the first section of accelerator guide in order to obtain high peak currents and minimum beam energy spread. A separately pulsed gun grid provides fast beam pulse rise time for use in neutron research. The accelerator and major electronics are housed in a single r.f. shielded rigid cabinet, which facilitates portability for field operations. The beam energy is continuously variable from 2 to 27 MeV; peak current for a 1 μsec pulse is 380 mA; pulse rate is variable from 1 to 200 pulses per sec; pulse length is variable from 0.2 to 2.4 μsec; and pulse rise time is adjustable from 0.2 to 0.4 μsec.

537.54

8241. DEMONSTRATING THE PRINCIPLE OF THE CYCLOTRON.
J.S.Miller.
Amer. J. Phys., Vol. 26, No. 7, 503 (Oct., 1958).

Gives details of a simple demonstration, using readily available equipment, showing the movement of charged particles in a combined electric and magnetic field. E.G.Knowles

537.54

8242. THE BEVATRON. E.J.Lofgren.
Proc. Nat. Acad. Sci. U.S.A., Vol. 45, No. 4, 451-6 (April, 1959).

General description of machine, including one method of extraction and analysis of secondary beams. J.W.Sturgess

537.54

8243. THE APPLICATION OF QUADRATIC NON-LINEARITIES IN AN ACCELERATOR WITH STRONG FOCUSING. Yu.F.Orlov.
Pribory i Tekh eksper., 1959, No. 2, 8-11 (March-April).
In Russian.

Calculations are presented of the effect of second-order non-linearities on the amplitude of particle oscillations. It is shown that, with the help of such non-linearities, the dependence of betatron frequency on momentum may be reduced. In particular, it is found possible to cancel out dangerous synchro-betatron resonances occurring at high multiples of the frequency of the accelerating voltage. J.H.Fremlin

537.54 : 538.08

MAGNETIC FIELD AND FIELD GRADIENT MEASURING INSTRUMENT FOR A SYNCHROTRON MAGNET. See Abstr. 7146

IONIZATION . PLASMA

537.56

8244. ON THE PROPERTIES OF A RAPIDLY VARYING PLASMA.
R.Rompe and H.Rother.
Ann. Phys. (Leipzig), Folge 7, Vol. 3, No. 1-2, 28-36 (1959).
In German.

Gives an analytical treatment of certain quantities, such as heat losses, conductivities etc., of plasmas with time-varying properties. Experiments were made with certain commercial arc lamps, the results showing reasonable agreement with the theory.
J.D.Craggs

537.56

8245. COHESION IN PLASMA. M.A.Cook and W.S.McEwan.
J. appl. Phys., Vol. 29, No. 11, 1612-13 (Nov., 1958).

Briefly describes a study of plasma emitted from a high explosive. It is suggested that the degree of ionization in such a plasma is much higher than would be consistent with Saha's equation and that this is due to the plasma's taking up a metal-like lattice form. J.D.Craggs

537.56

8246. KINETIC EQUATION FOR A PLASMA WITH UNSTEADY CORRELATIONS. C.M.Tchen.
Phys. Rev., Vol. 114, No. 2, 394-411 (April 15, 1959).

As a generalization of the Boltzmann equation, the kinetic equation for a plasma is derived in the form of a generalized Fokker–Planck equation, by considering unsteady correlations, including non-Markovian and nonlinear behaviour. Both the binary and ternary correlations are used for many kinds of particles with different temperatures. The coefficients of the kinetic equation depend on the law of interaction for a pair of particles and are influenced by relaxation. The effective potential of friction consists of two parts: the static part corresponds to the Debye potential and is isotropic, the dynamical part is axially symmetrical about the direction of motion, and causes a dynamical friction. The results show that the friction is proportional to velocity for slow particles, and inversely proportional to the square of velocity for last particles. This tendency of the fast particles to overcome repulsion is a property connected with the "run-away" of electrons. A criterion for maximum friction is derived. The triplet interaction, which mainly affects the shielding phenomena, assures the convergence of the coefficients in case of distant interaction. Since the length scales of interaction are well determined in this way, the kinetic equation can be expected to be valid over a longer range than does the Boltzmann equation. The large scale agrees with the Debye radius, when the shielding term is linearized, as should be expected. When time relaxation is left aside and linearization is made, the kinetic degenerates to the classical Fokker–Planck equation with convergent coefficients.

537.56

8247. ALTERNATIVE NEUTRAL BURNOUT EQUATION.
A.Simon.
Phys. of Fluids, Vol. 2, No. 3, 336-7 (May-June, 1959).

An alternative method of calculating the "burn-out" condition for the ignition of a thermo-nuclear plasma to that given previously by the author (Abstr. 4745 of 1959) in which self-shielding of the plasma is explicitly taken into account. C.G.Morgan

537.56

8248. THEORY OF ELECTROSTATIC PROBES IN A LOW-DENSITY PLASMA. I.B.Bernstein and I.N.Rabinowitz.
Phys. of Fluids, Vol. 2, No. 2, 112-21 (March-April, 1959).

The theory of spherical and cylindrical probes immersed in plasmas of such low density that collisions can be neglected is formulated. The appropriate Boltzmann equation is solved, yielding the particle density and flux as functionals of the electrostatic potential, the situation in the body of the plasma, and the properties of the probe. This information when inserted in Poisson's equation serves to determine the potential, and hence the probe characteristic. No a priori separation into sheath and plasma regions is required. Though amenable to a determination of the full probe characteristic, the method is applied in detail and numerical results are presented only for the collection of monoenergetic ions, for the case of negligible electron current. These results indicate that the potential is not so insensitive to ion energy as was believed, and that if the probe radius is sufficiently small, there enters the possibility of a class of ions which are trapped near the probe in troughs of the effective radial potential energy. The population of these trapped ions is determined by collisions, however infrequent. It is difficult to calculate, and conceivably can have a marked effect on the local potential.

537.56

8249. ON THE INERTIAL-ELECTROSTATIC CONFINEMENT OF A PLASMA. W.C.Elmore, J.L.Tuck and K.M.Watson.
Phys. of Fluids, Vol. 2, No. 3, 239-46 (May-June, 1959).

A system in which electrons are projected radially inwards from a spherical surface, was proposed for the confinement of a plasma at thermonuclear temperatures. The equilibrium, economics, and stability of such a system are discussed theoretically. Although it is concluded that it is of doubtful utility as a thermonuclear reactor, it may be possible to produce in this way small regions of thermonuclear plasma for study. The device appears to be unstable at economic densities. The stability is discussed in terms of a virial, which turns out to be mathematically tractable in this geometry.

537.56

8250. THE MICROFIELD ON A NEUTRAL PARTICLE IN THE PLASMA. G.Ecker and K.G.Müller.
Astrophys. J., Vol. 129, No. 3, 858-60 (May, 1959).

The probability distribution for the electric field acting on a neutral particle in a plasma has been calculated using the physical ideas of the Debye–Hückel theory. The results are presented graphically for various integral values of a parameter δ, the number of particles in the Debye region. (The Holtsmark distribution corresponds to $\delta = \infty$). The results are compared with those of previous less accurate calculations carried out by Ecker and by Hoffman and Theimer. O.Penrose

537.56

8251. SOME ASPECTS OF THE HIGH FREQUENCY GAS DISCHARGE. H.J.Oskam.
Ned. Tijdschr. Natuurke, Vol. 23, No. 1, 1-15 (Jan., 1957). In Dutch.

A review paper of the theory and experimental measurements of the behaviour of gas plasma in high frequency fields.
J.M.Hough

537.56

8252. OSCILLATIONS OF A FINITE COLD PLASMA IN A STRONG MAGNETIC FIELD. J.Dawson and C.Oberman.
Phys. of Fluids, Vol. 2, No. 2, 103-11 (March-April, 1959).

Of prime concern in plasma investigations is the coupling of a bounded plasma with external electromagnetic fields. In the present paper the properties of the normal modes of a cold plasma slab, and cylinder, situated in a strong magnetic field are derived, and then used to discuss the transmission and reflection of radiation, the scattering by a plasma cylinder, the response to driving sources in the vicinity of the plasma, and the radiation due to plasma oscillations.

537.56

8253. PLASMA OSCILLATIONS IN AN EXTERNAL STATIC MAGNETIC FIELD. S.Chulli and M.Miku.
Rev. de Physique (Bucarest), Vol. 3, No. 3-4, 211-18 (1958).
In Russian.

Reports studies of the steady-state distribution and small departures from it (oscillations) of a discharge in a gas under the action of an external axial constant magnetic field. A.Tybulewicz

537.56 : 536.23

8254. THE THERMAL CONDUCTIVITY OF A PLASMA.
H.Schirmer and J.Friedrich.
Z. Phys., Vol. 153, No. 5, 563-70 (1959). In German.

A theoretical paper dealing with the development of the Boltzmann equation in a study of "heat loss" components from discharges. Principal factors are electron transport, thermal diffusion, etc.
J.D.Craggs

537.56 : 539.18

8255. IONIZATION OF Fe XIV IN A HOT PLASMA.
S.B.Schwartz and H.Zirin.
Phys. of Fluids, Vol. 2, No. 1, 94 (Jan.-Feb., 1959).

Gives the results of a computation of the ionization cross-section of Fe XIV by electrons. These indicate considerably smalle values than generally supposed. C.G.Morgan

537.56

8256. SOME COMPRESSION WAVES IN PLASMAS. D.Reagan.
Phys. of Fluids, Vol. 2, No. 1, 93 (Jan.-Feb., 1959).

Analyses excitation of compression waves in high current discharges and applies results to data obtaining in the Harwell thermonuclear studies. C.G.Morgan

537.56 : 534.222.2

8257. SHOCK WAVES REFLECTED BY MAGNETIC FIELDS.
W.R.Atkinson, W.R.Holden and R.G.Fowler.
J. appl. Phys., Vol. 30, No. 6, 801-2 (June, 1959).

Fast moving plasmas encountering transverse magnetic fields of order 10^4 gauss are decelerated so rapidly as to produce reflected shock waves. Observations in hydrogen at gas pressures of 1 to about 10 mm Hg are analysed. There are critical conditions of magnetic field for the onset of the reflection. The velocities of the advancing and reflected waves are recorded as a function of pressure and field.

537.5

8258. OSCILLATIONS OF ELECTRON CLOUD IN EXTERNAL FIELDS. M.Sumi.
J. Phys. Soc. Japan, Vol. 12, No. 10, 1110-17 (Oct., 1957).

The collective behaviour of density fluctuations in a purely electronic cloud which is not neutralized by positive ions is analysed under the influence of external electromagnetic fields. In an equilibrium state the electrostatic space charge force is counterbalanced by the external fields and it gives rise to the mean drift flow of electronic cloud accompanying the oscillations similar to those in the usual plasma. The classical description leads to the dispersion relation, which involves additional terms due to the drift velocity of electron flow. The effect of this drift velocity on the frequency shift is briefly discussed.

537.5

8259. STATISTICAL PROBLEMS IN ENERGY LOSS AND IONIZATION PROCESSES. J.R.Herring and E.Merzbacher.
J. Elisha Mitchell Sci. Soc., Vol. 73, No. 2, 267-79 (Nov., 1957).

Relations are derived between the probability that a certain number of ion-pairs will be produced by a secondary electron of a given energy (in the electron-volt region) and the basic atomic cross-sections for excitation and ionization. Similar relations for the total number of ion-pairs produced by fast primary particles are proposed, and would entail modifications of the calculations by Moyal (Abstr. 3850 of 1955). Detailed numerical results for ionization of atomic H by electrons are given. The Landau distribution of the energy of emergent particles is re-derived by this method, which involves only the statistical study of the detailed processes involved, and leads to a proposal for a Monte Carlo method for obtaining the distribution. J.Hawgood

537.56

8260. IONS FORMED IN A ROOM BY A POLONIUM ION GENERATOR. H.Norinder and R.Siksna.
Ark. Geofys., Vol. 2, Paper 24, 501-14 (1957).

Describes a very detailed series of measurements made on the ions produced in air by a Po ion generator. The ions were classified on a mobility basis. Measurements of ion densities and rates of decay, etc., were made. The effects of air blowing were also investigated. J.D.Craggs

537.56

8261. IONIZATION OF ARGON WITH HYDROGEN IONS.
V.V.Afrosimov, R.N.Il'in and N.V.Fedorenko.
Zh. tekh. Fiz., Vol. 28, No. 10, 2266-74 (1958). In Russian.

Describes with details an investigation of secondary ions produced in single collisions of H^+, H_2^+ and H_3^+ in the range of 5-180 keV with A atoms. The same apparatus was used as in previous works (Abstr. 2367-8 of 1957). It was found that: (a) in all cases total capture cross-section of electrons by H ions decreases with an increase of velocity of primary ions; (b) total formation cross-section of free electrons and total formation cross-sections of $A^{++}A^{+++}A^{++++}$ reach maxima when primary ions velocities are in the region of $e^2/\hbar$; (c) total formation cross-sections of $A^{++}A^{+++}A^{++++}$ increase with increase of the charge on primary ions in the case of atomic ions; and they increase with the number of nuclei in the case of molecular ions. J.M.Zarzycki

537.56

8262. MOBILITY OF HYDROGEN IONS (H^+, $H_2{}^+$, $H_3{}^+$) IN HYDROGEN. E.A.Mason and J.T.Vanderslice.
Phys. Rev., Vol. 114, No. 2, 497-502 (April 15, 1959).

Force laws for H^+, $H_2{}^+$, and $H_3{}^+$ in H_2 are calculated from theory and from results on the scattering of low-velocity ion beams in H_2 gas. These results are then used to calculate the mobilities of the hydrogen ions in H_2 gas as a function of temperature. The mobilities of H^+ and $H_2{}^+$ decrease slightly with increasing temperature, but the mobility of $H_3{}^+$ increases strongly. The agreement with experiment indicates that the unidentified hydrogen ion whose mobility has been measured is probably $H_2{}^+$, rather than the usually assumed $H_3{}^+$.

537.56

8263. IONIZATION POTENTIALS OF METHYLAMINES AND ETHYLAMINES BY ELECTRON IMPACT. J.Collin.
Canad. J. Chem., Vol. 37, No. 6, 1053-5 (June, 1959).

Recent determinations of the ionization potentials obtained by electron impact have been compared with photoionization results and discussed in relation to the Franck—Condon principle. It seems that the observed discrepancies are mainly due to differences in the sensitivities of the detecting devices.

537.56

8264. IONIZATION POTENTIALS. II. THE LISITZIN EFFECT.
C.G.Bedreag.
Rev. de Physique (Bucarest), Vol. 2, No. 2, 183-98 (1957).
In French.

For Pt I see Abstr. 2357 of 1957. A discussion of the systematics of ionization potentials, particularly for cases of multiple ionization, with special reference to Lisitzin's study of isoelectronic series etc. A brief quantum-mechanical interpretation of certain regularities is given. J.D.Craggs

537.57 : 532.58

8265. ION DRAG PRESSURE GENERATION. O.M.Stuetzer.
J. appl. Phys., Vol. 30, No. 7, 984-94 (July, 1959).

A theory of pressure build-up under unipolar ion conduction is presented and verified experimentally. Constriction of the current flow leads to sizeable pressures in insulating liquids.

COSMIC RAYS

537.591

8266. THEORY OF THE COSMIC RAY EQUATOR. R.Ingraham.
Nuovo Cimento, Vol. 12, No. 4, 356-68 (May 16, 1959).

The 45° westward shift of the cosmic-ray equator from the geomagnetic equator is explained by assuming that there exist ionized atmospheric layers which rotate more slowly than the earth. The resultant magnetic field beyond the layers is then a dipole field whose magnetic north pole is west of the familiar geomagnetic north pole. The condition that this longitudinal shift be 45° determines $\Delta\omega \equiv \omega' - \omega$ as a function of certain radial moments of the conductivity of the layer (ω', ω = rotational velocities of layer and earth, respectively). The effect would vanish if either $\Delta\omega = 0$ or if the earth's intrinsic dipole axis were not tilted.

537.591

8267. APPARATUS SUITABLE FOR SELECTION OF COSMIC RAY PARTICLES OF MASS ABOUT 550 m_e.
M.Conversi, G.M.De'Munari, A.Egidi, E.Fiorini, S.Ratti, C.Rubbia, C.Succi and G.Torelli.
Nuovo Cimento, Vol. 12, No. 2, 130-37 (April 16, 1959). In Italian.

The apparatus employed in a search for the 550 mass particles reported by Alihanian et al. is described. Unwanted particles are eliminated electronically by a suitable arrangement of scintillation — Cherenkov — and G.M. counters. The recorded particles are observed in a large multiplate cloud chamber. The mass is essentially deduced by the combined measurements of range in this chamber and dE/dx in a proportional liquid scintillator. It is shown that the background of spurious 550 mass particles is entirely negligible and that genuine 550 mass particles could not be missed.

537.591.1

8268. INVESTIGATION OF THE EXISTENCE OF PARTICLES OF MASS ABOUT 550 m_e IN COSMIC RAYS.
M.Conversi, G.M.De Munari, A.Egidi, E.Fiorini, S.Ratti, C.Rubbia, C.Succi and G.Torelli.
Nuovo Cimento, Vol. 12, No. 2, 148-55 (April 16, 1959). In Italian.

The results are reported of a cosmic-ray experiment carried out at an altitude of 2550 m above sea level to search for the 550 mass particles reported by Alihanian et al. No event has been found out of 25 expected on the basis of the rate given by these authors. This negative result is compared with the results of other workers. The possibility for pions and protons to appear as 550 mass particles when undergoing unidentified nuclear interactions is discussed.

537.591.1

8269. SOME CONSIDERATIONS ON THE ANALYSIS OF PRIMARY COSMIC RAY INTENSITY EXPERIMENTS.
A.Engler, M.F.Kaplon and J.Klarmann.
Nuovo Cimento, Vol. 12, No. 4, 310-26 (May 16, 1959).

A discussion is given of the procedures employed in the analysis of primary cosmic-ray intensity experiments and the assumptions inherent in their use, with particular emphasis on nuclear emulsion as a detector. Explicit formulae for extrapolation of particle intensities for various geometries employed in emulsion work are given. Some discussion of geomagnetic effects is given and data are presented showing that the earth's shadow cone is not appreciably present at a geomagnetic latitude of 40°.

537.591.15

8270. MEASUREMENT OF THE ABSORPTION LENGTH OF PENETRATING SHOWER PRODUCING COSMIC RAY PARTICLES IN LEAD. G.Bozóki, E Fenyves and L.Jánossy.
Nuclear Phys., Vol. 11, No. 3, 531-9 (June (1), 1959).

The absorption length of penetrating shower producing particles was measured in lead under great absorber thicknesses by means of a penetrating shower detector. In order to select single nuclear active particles, local penetrating showers were detected, and the coincidence rates measured were corrected for spurious effects. The absorption length was found to be 414 ± 17 g/cm^2, in good agreement with the results of other experiments. The mean energy of the recorded penetrating shower producing particles was estimated to be between 30 and 60 GeV.

537.591.3

8271. ABSORPTION MEASUREMENTS OF COSMIC RADIATION WITH A SCINTILLATION COUNTER. C.Burckhardt.
Helv. phys. Acta, Vol. 29, No. 5-6, 533-44 (1956). In German.

Cosmic ray events were recorded in a scintillation spectrometer fitted with a cylindrical crystal of NaI(Tl) 37 mm in diameter and 22 mm in height. Pulses were recorded in a multi-channel pulse analyser previously described [Burckhardt, Helv. phys. Acta, Vol. 27, 176 (1954)]. A liquid scintillation counter shielding the crystal permitted the distinguishing of events produced by charge and neutral primaries. Horizontally placed sheets of cast iron were used as absorbers. The apparatus was raised above ground to reduce albedo. The pulse size distribution in the unshielded crystal is given for events causing 5 to 500 MeV pulses in the crystal. Absorption curves were obtained for events corresponding to energy relases exceeding 5, 10, 20, 40, and 80 MeV in the crystal. Energy relases > 80 MeV are ascribed to stars in the crystal. Both charged and neutrally produced stars show marked transition effects with maxima at 25 g cm^{-2} of Fe and suggest second maxima at about 100 g cm^{-2} similar to those observed by Schopper et al. in emulsion and scintillators (Abstr. 1971-2 of 1955). E.G.Michaelis

537.591.5

8272. LOW ENERGY PROTON FLUX AT SEA LEVEL.
I.B.McDiarmid.
Canad. J. Phys., Vol. 37, No. 1, 79-81 (Jan., 1959).

The vertical proton flux at 57°N was measured with a cloud chamber and found to be $(2.4 \pm 0.3) \times 10^{-7}$ cm^{-2} sec^{-1} sterad^{-1} (MeV/c)$^{-1}$ for the interval 716-739 MeV/c and $(1.3 \pm 0.1) \times 10^{7}$ for 739-828 MeV/c. E.J.Burge

537.591.5

8273. STORM-TIME INCREASE OF COSMIC-RAY INTENSITY.
S.Yoshida and M.Wada.
Nature (London), Vol. 183, 381-3 (Feb. 7, 1959).

An analysis is given of two typical sudden increases in cosmic-ray intensity observed on Sept. 13, 1957, and Feb. 11, 1958. These are shown to have been world-wide in incidence, and to have coincided with severe magnetic storms; large solar flares were observed approximately two days before.

537.591.5 : 551.510.535

ABNORMAL IONIZATION IN THE LOWER IONOSPHERE ASSOCIATED WITH COSMIC-RAY FLUX ENHANCEMENTS. See Abstr. 7681

537.591.8

8274. COSMIC RAY NUCLEAR INTERACTIONS IN NITROGEN GAS. S.Miyake, K.Hinotani, I.Katsumata and T.Kaneko.
J. Phys. Soc. Japan, Vol. 12, No. 8, 845-54 (Aug., 1957).

The natural rate of occurrence of nuclear interactions of the cosmic-ray N-component in which more than 5 MeV are given to charged secondary particles was measured in a nitrogen filled high-pressure cloud chamber at Mt. Norikura (2840 m above sea level and 25°N geomagnetic latitude). From the rate of occurrence of interactions, the vertical intensity of N-component was estimated at $(2.4 \pm 40\%) \times 10^{-3} \times E^{-1.4}$ cm^{-2}sec^{-1}sr^{-1}MeV^{-1} for the energy range from 10 MeV to 100 MeV by assuming a geometrical cross-section. These events may be considered to be the source of the cosmic-ray N-component with an energy less than that sufficient to produce nuclear interactions in the atmosphere, and it was shown that the spectrum of secondary particles was in accord with that of the latter. The absolute intensity of the N-component was also consistent with that expected from the data of other regions in a previous paper. A possible scheme of the nuclear cascade is discussed in relation to the size distribution of the observed stars.

537.591.8 : 551.594.14

COSMIC RAY PRODUCED SHORT-LIVED P^{32}, P^{33}, Be^{7} AND S^{35} IN TROPICAL LATITUDES. See Abstr. 7695

537.591.8 : 551.594.14

INFLUENCE OF COSMIC RADIATION ON THE ISOTOPIC COMPOSITION OF THE ELEMENTS. See Abstr. 7696

MAGNETISM

MAGNETIC RESONANCES

538.07

8275. A NULL-COIL MAGNETOMETER.
P.Jongenburger and C.W.Berghout.
Appl. sci. Res. B, Vol. 7, No. 5, 366-78 (1959).

A magnetometer has been developed in which the saturation-magnetization of small samples of ferromagnetic materials can be measured. The sample, which is situated at the centre of a small coil, is placed in an inhomogeneous magnetic field. The current through the coil is adjusted to such a value that the forces on coil and sample balance each other. Then under certain conditions the magnetic moment of the sample equals the magnetic moment of the coil; these conditions are discussed. The method is suitable for use in ordinary laboratory magnets and in solenoids, and also at low temperatures. With a second version of this magnetometer it is possible to measure para- and even diamagnetism.

538.07

8276. EQUIPMENT FOR THE PRECISE MEASUREMENT OF THE COERCIVE FORCE IN THE RANGE 10^{-3}-10^{2} Oe. Z.Malek.
Czech. J. Phys., Vol. 7, No. 1, 97-101 (1957). In Russian.

The coercive force can be determined with an accuracy of 0.9% on samples weighing more than 1 g. The magnetic field is designed to be homogeneous and is calibrated by the method of paramagnetic resonance of free radicals. Zero magnetization is measured by a rotating probe composed of two small coils connected in anti-phase. J.M.Hough

538.1 : 550.389

MAGNETIC DIPOLE NOMOGRAMS. See Abstr. 7663

538.1 : 538.27

8277. PRODUCTION OF VERY HOMOGENEOUS AXIALLY SYMMETRIC MAGNETIC FIELDS. H.Primas and H.H.Günthard.
Helv. phys. Acta, Vol. 30, No. 4, 331-46 (1957). In German.

It is shown, theoretically and experimentally, that the decrease of an axially symmetric magnetic field away from the axis may be compensated to give a homogeneity of 1 part in 10^{8} over a small region on the axis by using simple current shims. The effect of random unevenness of the faces of magnet pole pieces is considered with particular reference to high resolution nuclear resonance. A.J.Manuel

538.1

8278. THERMODYNAMICS OF IRREVERSIBLE PROCESSES IN A [MAGNETICALLY] POLARIZED MAGNETOELASTIC MEDIUM. I.
K.B.Vlasov.
Fiz. Metallov i Metallovedenie, Vol. 4, No. 3, 542-4 (1957).
In Russian.

538.2

8279. DIAMAGNETIC SUSCEPTIBILITY OF PERTURBED SYSTEMS. E.Kapuy.
Acta phys. Hungar., Vol. 9, No. 4, 475-7 (1959).

Uses a variational procedure to calculate the susceptibility of HeH^{2+} as a function of the internuclear separation. The results provide an explanation of the change of susceptibility on melting and the increase with temperature. D.J.Olive

538.2

8280. ANOMALOUS MAGNETIC BEHAVIOUR IN A SINGLE CRYSTAL OF $Cu(NH_3)_4SO_4.H_2O$ AT LIQUID HELIUM TEMPERATURES. T.Watanabe and T.Haseda.
J. chem. Phys., Vol. 29, No. 6, 1429-30 (Dec., 1958).

The components of the magnetic susceptibility of a single crystal along the crystallographic a-, b- and c-axes were measured between 1.04° and 20°K. Above 14°K a Curie—Weiss Law holds, the g-values being 2.00, 2.05 and 2.11, respectively. The susceptibility passes through a maximum at 3.4°K. It is suggested that this behaviour is connected with the linear chain structure of the salt.

E.F.W.Seymour

538.2 : 536.631

8281. THERMAL AND MAGNETIC PROPERTIES OF PRASEODYMIUM ETHYLSULPHATE BELOW 1°K. H.Meyer.
J. Phys. Chem. Solids, Vol. 9, No. 3-4, 296-301 (March, 1959).

Single crystals of praseodymium ethylsulphate have been cooled below 1°K by adiabatic demagnetization and the susceptibility, expressed in terms of the magnetic temperature T*, was measured as a function of T, using cerium magnesium nitrate as a thermometer. The specific heat was measured by electrically hheating the sample. A systematic departure of the susceptibility from Curie's law and an anomaly in the specific heat were found. The results were interpreted and confirmed the existence of a variable splitting of the ground doublet, as predicted from paramagnetic-resonance experiments, with a root-mean-square value of $\Delta_0 = (0.53 \pm 0.04)$°K, which is much larger than the one in the diluted salt.

538.2

8282. MEASUREMENTS ON THE MAGNETIC SUSCEPTIBILITIES OF Ag—Mn AND Cu—Mn ALLOYS.
A.van Itterbeek, R.Pollentier and W.Peelaers.
Appl. sci. Res. B, Vol. 7, No. 5, 329-37 (1959).

Measurements were carried out with different concentrations of manganese between room temperature and liquid hydrogen temperatures. A paramagnetic behaviour was found. The dependence was examined of the susceptibilities on the field strength; no field dependence could be detected except in some of the Ag—Mn alloys, but this effect originated from small ferromagnetic impurities which were determined by means of the method of Honda. The concentration of the manganese was determined magnetically and compared with determinations based on the electrical resistance.

538.2 : 535.343

MAGNETIC PROPERTIES OF IRRADIATED LiF.
See Abstr. 7953

538.2 : 548.736.3 : 537.311.33

MAGNETIC SUSCEPTIBILITY OF RECTIFYING CUPROUS OXIDES. See Abstr. 8103

538.2

8283. THE PARAMAGNETIC SUSCEPTIBILITY OF SOME NICKEL SALTS. T.Haseda and M.Date.
J. Phys. Soc. Japan, Vol. 13, No. 2, 175-8 (Feb., 1958).

These were measured in the temperature range between 1.40° and 290°K. The flat behaviour of the susceptibility v. temperature curve in the lowest temperature region was especially prominent in $NiCl_2.6H_2O$. The paramagnetic susceptibility of a powdered specimen of the nickel salt was calculated with the low field approximation. The characteristic behaviour of a nickel ion in various salts was explained as due to the Stark splitting of the lowest spin triplet. The measured values of susceptibility were analysed and consistent results were obtained. Especially in $NiCl_2.6H_2O$, the crystalline field was expected to be much deformed from cubic symmetry and this is consistent with the fact that the paramagnetic resonance could not be detected at 9800 and 18000 Mc/s in this salt.

538.2

8284. HARD MAGNETIC MATERIALS. E.P.Wohlfarth.
Advances in Phys., Vol. 8, 87-224 (April, 1959).

A comprehensive review of the following topics: theoretical considerations, particularly fine particle theory; metallic powder materials; iron oxide and related powder materials; magnetically hard ferrites; ferromagnetism and superparamagnetism of dilute alloys; Alnico-type permanent magnet alloys; other permanent magnet alloys. 52 figures, 6 plates, about 600 refs.

E.P.Wohlfarth

538.2

8285. MAGNETIC PROPERTIES OF THE SYSTEM $Ni_{(1-x)}Li_xO$ BETWEEN 80 AND 300°K. N.Perakis, J.Wucher and G.Parravano.
C.R. Acad. Sci. (Paris), Vol. 248, No. 16, 2306-8 (April 20, 1959).
In French.

Measurements on materials of composition x = 0.2 and 0.3 showed that below 230-250°K the susceptibility depends on the magnetic field strength and increases rapidly with decreasing temperature, except for an inflection at ~ 95°K. Results depend on the history of the specimen. Ferrimagnetism apparently increases as x increases from 0 to 0.5, and not merely over the range x = 0.3 to 0.5, as previously found.

R.C.Kell

538.2

8286. A THERMODYNAMIC THEORY OF "WEAK" FERROMAGNETISM OF ANTIFERROMAGNETICS. I.Dzyaloshinsky.
J. Phys. Chem. Solids, Vol. 4, No. 4, 241-55 (1958).

A thermodynamic theory of "weak" ferromagnetism of α-Fe_2O_3, $MnCO_3$ and $CoCO_3$ is developed on the basis of Landau's theory of phase transitions of the second kind. It is shown that the "weak" ferromagnetism is due to the relativistic spin-lattice and the magnetic dipole interactions. A strong dependence of the properties of "weak" ferromagnetics on the magnetic crystalline symmetry is noted and the behaviour of these ferromagnetics in a magnetic field is studied.

538.2

8287. A FERROMAGNETIC DYNAMICAL EQUATION.
H.B.Callen.
J. Phys. Chem. Solids, Vol. 4, No. 4, 256-70 (1958).

Based on general considerations concerning the dissipative mechanism, a ferromagnetic dynamical equation is proposed. This equation contains three parameters, which have definite quantum-mechanical significance. A simple theory for one such parameter is given, and an explicit rotational dynamic equation is obtained in the special case in which the $(k = 0) \rightarrow (k \neq 0)$ spin-wave transitions dominate the dissipative process. It is suggested that certain observed size and shape effects may be explained qualitatively on the basis of this equation.

538.2 : 548.74

8288. MAGNETIC AND CRYSTALLOGRAPHIC ANALYSIS BY ELECTRON DIFFRACTION. S.Yamaguchi.
Nuovo Cimento, Vol. 12, No. 3, 286-9 (May 1, 1959).

The Lorentz effect observable in electron diffraction is utilized for measurement of the magnetization of ferromagnetic substances. In the present study, the martensitic transformed layer of austenitic stainless steel was studied magnetically and crystallographically by electron diffraction.

538.2

8289. MAGNETIC PROPERTIES OF THE $FeTiO_3$—Fe_2O_3 SOLID SOLUTION SERIES. Y.Ishikawa and S.Akimoto.
J. Phys. Soc. Japan, Vol. 12, No. 10, 1083-98 (Oct., 1957).

Magnetic properties of the synthesized solid solution $x\,FeTiO_3{\cdot}(1-x)Fe_2O_3$ of ilmenite ($FeTiO_3$) and hematite (Fe_2O_3) were investigated in detail for the whole range of $0 \leq x \leq 1$. The most suitable method for preparing the specimen with the largest intensity of magnetization was found experimentally. Changes of the Curie point, estimated intensity of magnetization at 0°K, the Curie constant and the asymptotic paramagnetic Curie point with the composition were presented. It was found that the magnetic properties of the solid solution $xFeTiO_3{\cdot}(1-x)Fe_2O_3$, could be divided into three parts, (i) $x = 1$, (ii) $1 > x \geq 0.5$ and (iii) $0.5 \quad x \geq 0$: Pure ilmenite ($FeTiO_3$) is antiferromagnetic below 55°K and the specimens for $1 > x \geq 0.5$ are very strongly ferromagnetic and for $0.5 > x \geq 0$ they are again antiferromagnetics on which feeble parasitic ferromagnetism is superimposed. These magnetic properties are discussed by using the approximation of molecular field. It is shown that one could explain an outline of the magnetic properties of the solid solution if it is assumed that the tetravalent Ti ions always occupy one of the two sublattices in the specimens for $1 \geq x \geq 0.5$, while such an ordering of Ti ions and Fe ions is disturbed for $0.5 > x \geq 0$.

538.2

8290. NEW MAGNETIC COMPOUNDS OF THE ILMENITE-TYPE STRUCTURE. T.J.Swoboda, R.C.Toole and J.D.Vaughan.
J. Phys. Chem. Solids, Vol. 5, No. 4, 293-8 (1958).

Two new ferromagnetic oxides, $CoMnO_3$ and $NiMnO_3$, have been synthesized by reacting the appropriate binary oxides under hydrothermal conditions. These compounds have rhombohedral, ilmenite-type crystal structures, i.e. they are isomorphous with $FeTiO_3$ and are believed to be the first oxides with this structure reported to be ferromagnetic. The specific moment of each oxide is of the order of 14 c.g.s. units/g at room temperature. Intrinsic coercive forces as high as 9000 Oe for $CoMnO_3$ and 1240 Oe for $NiMnO_3$ have been observed for samples of these oxides that have been severely cold worked. The magnetic properties of $CoMnO_3$ and $NiMnO_3$ indicate that they possess high magnetocrystalline anisotropies and that their direction of easy magnetization does not lie along the principal crystallographic symmetry axis but lies probably in the basal plane.

538.2

8291. FERROMAGNETIC MOMENT OF $CoMnO_3$.

R.M.Bozorth and D.E.Walsh.

J. Phys. Chem. Solids, Vol. 5, No. 4, 299-301 (1958).

The magnetic moment of $CoMnO_3$, extrapolated to 0°K and infinite field strength, is 0.72 Bohr magneton per molecule. This is interpreted as antiferromagnetic coupling between layers of cobalt and manganese ions, the difference in moment being attributed to the orbital moment of the cobalt ion.

538.2

8292. AN INTERPRETATION OF THE MAGNETIC PROPERTIES OF THE PEROVSKITE-TYPE MIXED CRYSTALS $La_{1-x}Sr_xCoO_{3-\lambda}$.

J.B.Goodenough.

J. Phys. Chem. Solids, Vol. 6, No. 2-3, 287-97 (Aug., 1958).

It is pointed out that trivalent cobalt with an octrahedral coordination of oxygen ions has a low-spin and a high-spin state of comparable energy. The anomalous magnetic properties of the perovskite-type mixed crystals $La_{1-x}Sr_xCoO_{3-\lambda}$ are interpreted in the light of this fact. It is assumed that the tetravalent cobalt ion is always in the low-spin state in this system. It is shown how the geometry of the perovskite-type lattice lends itself to the formation of two sublattices, each consisting of a set of (111) planes, in one of which the cobalt ions are predominantly in a high-spin state and in the other in a low-spin state. Experiments indicate that the magnetic interaction between trivalent cobalt ions in the high-spin state is antiferromagnetic, whereas the interaction between the low-spin tetravalent cobalt ions and the high-spin trivalent cobalt ions is ferromagnetic. These interactions are considered in relation to modified superexchange and the semicovalent-exchange models. The ferromagnetic Co^{3+}-Co^{IV} interaction permits a sharp distinction to be made between the two, although there is always some ambiguity in qualitative models. Further, the ferromagnetic interaction can be understood without recourse to Zener's double-exchange mechanism.

538.2 : 537.311.31

FERROMAGNETIC PROPERTIES OF Ni–Cu AND Ni–Cr ALLOYS AND OF Ni AND Pd FILMS. See Abstr. 8092

538.2

8293. STUDIES ON THE MAGNETIC ANISOTROPY INDUCED BY COLD ROLLING OF FERROMAGNETIC CRYSTAL. I. IRON–NICKEL ALLOYS. S.Chikazumi, K.Suzuki and H.Iwata.

J. Phys. Soc. Japan, Vol. 12, No. 11, 1259-76 (Nov., 1957).

Magnetic domain patterns were observed and torque measurements made on single crystals of Ni_3Fe. The easy magnetizing direction was found to be normal to the roll direction for (110) [001] and (001) [100] rolling, while it changes to parallel to roll direction at about 30% reduction for (001) [110] rolling. The maximum value of uniaxial anisotropy was $(2\text{-}3) \times 10^5$ erg/cm^3. The results were satisfactorily explained by assuming the appearance of directional order by slip deformation. It was shown theoretically that the anisotropies thus induced are classified into longe range order (fine slip) type and short range order (coarse slip) type. Relation to the superlattice formation was also discussed.

538.2 : 537.311.32

8294. MAGNETIC AND ELECTRICAL ANISOTROPIES OF IRON SULFIDE SINGLE CRYSTALS. E.Hirahara and M.Murakami.

J. Phys. Chem. Solids, Vol. 7, No. 4, 281-9 (Dec., 1958).

Single crystals of iron sulphide of stoichiometric and near-stoichiometric compositions were prepared by a method similar to the Bridgman technique, and their anisotropies of magnetic susceptibility and electrical conductivity have been observed. Consideration of the experimental results leads to the conclusion that the preferred direction of the antiferromagnetic spins is parallel to the c-axis of the crystal below T_α (the temperature of the α-transformation) and perpendicular to the c-axis above T_α. The behaviour of the spin orientation in the temperature range between T_α and T_N (the Néel temperature) has been clarified. It appears that the anisotropy of conductivity can be explained qualitatively in terms of the dependence of electron scattering on the spin orientation of each magnetic ion in the crystal. Anomalous behaviour of the susceptibility, which appears just below T_α in the cooling process, is reported briefly.

538.2

8295. THE INFLUENCE OF DISLOCATIONS ON THE COERCIVITY OF IRON. Z.Málek.

Czech. J. Phys., Vol. 7, No. 3, 335-8 (1957). In German.

A formula due to Vicena (Abstr. 7511 of 1956), relating coercivity to dislocation density, was tested experimentally on iron wires under different degrees of strain s. The formula gives $H_c \propto s^{\frac{1}{4}}$, in good agreement with the observations.

E.P.Wohlfarth

538.2

8296. THE CONNECTION BETWEEN THE COERCIVE FORCE AND THE INITIAL SUSCEPTIBILITY OF PLASTICALLY DEFORMED FERROMAGNETICS. K.Wotruba.

Czech. J. Phys., Vol. 7, No. 5, 568-76 (1957).

Measurements on four ferromagnetic materials, plastically deformed in broad limits, show that between the coercive force and the inverse value of the initial susceptibility there exists a linear correlation. With two of the given materials this correlation can be explained on the basis of the Becker–Kersten theory of coercive force and initial permeability. The paper also describes the experimental equipment used and gives practical principles in the construction of the coercimeter and permeameter. It also gives a method of determining the influence of the skin-effect of the magnetic field on the results of measurement.

538.2

8297. CONTRIBUTION TO THE QUANTITATIVE STUDY OF DIFFUSION MAGNETIC LAG OF CARBON IN ALPHA IRON.

P.Brissonneau.

J. Phys. Chem. Solids, Vol. 7, No. 1, 22-51 (Oct., 1958). In French.

A magnetic lag of considerable magnitude has been found and measured in very dilute solid solutions of carbon in iron. The results are interpreted by Néel's theory. Measurements of the time decrease of the induction allow the determination of the diffusion lag field, which can be separated into the contributions due to the 90° and 180° Bloch walls and for which theory gives a simple expression. The diffusion mechanism can be accurately represented only by introducing a fairly wide range of time constants. A large number of anomalies has been found and interpreted in a.c. fields, but in this case, the quantitative measurements are greatly hindered by hysteresis and eddy currents. It seems that the measurement of the diffusion lag field could be used as a very sensitive method for the quantitative determination of dissolved impurities.

538.2

8298. MAGNETIC DOMAIN OBSERVATIONS BY ELECTRON MICROSCOPY. M.E.Hale, H.W.Fuller and H.Rubenstein.

J. appl. Phys., Vol. 30, No. 5, 789-91 (May, 1959).

Preliminary observations of domain patterns, by transmission, in thin films of iron, 50/50% iron–nickel alloy and permalloy are reported.

A.J.Manuel

538.2

8299. DIRECT OBSERVATION OF MAGNETIC DOMAINS IN CEMENTITE. M.Hillert and N.Lange.

J. appl. Phys., Vol. 30, No. 6, 945 (June, 1959).

The observation of magnetic domain patterns in cementite (Fe_3C), using the Kerr magneto-optic effect is reported. Photograph show the variation of domain pattern with applied magnetic field, as the specimen is taken through an hysteresis cycle.

S.A.Ahern

538.2

8300. DISTRIBUTION OF MAGNETIC DOMAINS BETWEEN THE TWO PHASES IN A SINGLE-CRYSTAL FLAT DISK OF IRON.

K.F.Neissen.

Philips Res. Rep., Vol. 14, No. 2, 101-10 (April, 1959).

A single-crystal oblate spheroid of iron is considered, whose plane is a (001) plane of the crystal. It is subjected to a magnetic field H lying in the first quadrant of this plane, making an angle θ with the second of the two preferential axes [100], [010] which lie also in the plane. The total number of magnetic domains is called N, all being of the same moment m, whereas Nm is supposed to be known. The ratio in which these domains are distributed between the preferential directions of the crystal depends on the strength H of the external field. The graphical determination of this ratio is th aim of the present paper. It is compared with the analytical determination given by Néel [J. Phys. Radium, Vol. 5, 241-51(1944)] and by Lawton and Stewart (Abstr. 1281 of 1948).

538.2 : 539.2 : 539.27

8301. ELECTRON MIRROR MICROSCOPY OF MAGNETIC STRA FIELDS ON GRAIN BOUNDARIES. L.Mayer.

J. appl. Phys., Vol. 30, No. 7, 1101-4 (July, 1959).

Experimental evidence is presented that electron mirror microscopy is particularly well suited for direct visual observation of magnetic stray fields at grain boundaries in magnetic materials.

Silicon—iron disks were used as specimens. By mounting these specimens on a special magnetic stage of axial symmetry, the appearance and the growth of magnetic stray fields with increasing external applied magnetic fields could be observed directly, and motion picture recordings were taken from the viewing screen of the microscope. A series of electron mirror micrographs shown demonstrates that grain boundaries behave quite differently stray field-wise. The fact that magnetic stray fields on grain boundaries are now accessible to direct visual observation is considered valuable for many magnetic investigations. The still controversial subject of grain size effects on the magnetic properties of such important magnetic materials as silicon—iron is one subject which might profit from these potentialities inherent in electron mirror microscopy. This electronic observation method might also be helpful in grain boundary studies concerned with the basic physics of magnetics in such narrow regions of distorted order.

538.2

8302. SPIN FLUCTUATION SCATTERING OF NEUTRONS IN MAGNETITE. T.Riste, K.Blinowski and J.Janik.

J. Phys. Chem. Solids, Vol. 9, No. 2, 153-64 (Feb., 1959).

Observations on the peak widths and intensities of inelastically scattered neutrons from Fe_3O_4 are found to agree with spin-wave theory over a wide range of temperatures. The quadratic dispersion relation for ferrimagnetic spin waves is verified, and the value of $J_{AB} - 2 \times 10^{-3}$ eV is in agreement with an earlier result by Brockhouse (Abstr. 7441 of 1957). The statistical behaviour of spin waves (magnons) is found to be well described by Bose—Einstein statistics. The maximum temperature for the validity of the spin-wave approximation is seen to be a function of the magnon energy. At higher temperatures fluctuations are also found to exist in the z-component of the spins.

538.2

8303. ON THE THEORY OF THE SPONTANEOUS MAGNETIZATION OF THIN FILMS. I. L.Valenta.

Czech. J. Phys., Vol. 7, No. 2, 127-35 (1957). In Russian, with summary (3 pp.) in English.

Treats the atomic planes in a thin film as effective magnetic sub-lattices and thus calculates statistically the temperature dependence of the magnetization, which is given by a hyperbolic tangent law. This result is equivalent to that derived on the basis of a molecular field treatment. E.P.Wohlfarth

538.2

8304. ON THE THEORY OF THE SPONTANEOUS MAGNETIZATION OF THIN FILMS. II. L.Valenta.

Czech. J. Phys., Vol. 7, No. 2, 136-51 (1957). In Russian, with summary (3 pp.) in English.

The equations of the molecular field treatment are solved, and application is made to Fe, Co and Ni films whose Curie temperatures are also discussed on this basis. The agreement with experiment is only fair, and reasons for this are proposed. E.P.Wohlfarth

538.2

8305. ON THE ORIGIN OF THE MAGNETOMECHANICAL PHENOMENON IN AN ALTERNATING MAGNETIC FIELD. K.Míšek.

Czech. J. Phys., Vol. 7, No. 2, 247-8 (1957).

From observations on the damping of torsional oscillations of nickel wires of different diameters as a function of longitudinal alternating magnetic field, it is concluded that the pronounced internal friction peak previously observed (see Abstr. 4557 of 1957) arises from microscopic eddy currents due to reversible Bloch wall displacements. A.J.Manuel

538.2

8306. THE INFLUENCE OF TENSION STRAINS ON THE REMANENCE OF α-IRON AT HIGH TEMPERATURES. B.J.Shepstone and L.Alberts.

Z. Naturforsch.,Vol. 13a, No. 12, 1096-7 (Dec., 1958). In German.

The observed variation of remanence with tension is, except near the Curie temperature, in agreement with that calculated assuming magnetization to take place by domain rotation.

A.E.De Barr

538.2

8307. EFFECT OF A SMALL PROPORTION OF COBALT ON THE MAGNETIC DISPERSION OF NICKEL-ZIN FERRITES. A.Marais.

C.R. Acad. Sci. (Paris), Vol. 248, No. 16, 2303-5 (April 20, 1959). In French.

The product of permeability and resonant frequency is approximately proportional to the saturation magnetization for different nickel—zinc ratios. A small amount of cobalt increases the constant of proportionality. This result is contrary to that expected from consideration of the resonance of rotation of spins of domains. R.C.Kell

538.2

8308. FLUX REVERSAL IN SOFT FERROMAGNETICS. F.B.Humphrey and E.M.Gyorgy.

J. appl. Phys., Vol. 30, No. 6, 935-9 (June, 1959).

To describe the flux reversal process in soft ferromagnetics, at least three mechanisms are required. A domain wall motion process is satisfactory only when the drive field is slightly larger than the coercive force. In the intermediate drive region, a nonuniform rotation model is necessary to be consistent with the experimental observations. In particular such a model predicts the observed linear relationship between drive and the inverse of the reversal times, the observed shape of the flux reversal transient and the observed value of the switching coefficient. In the high drive region with a transverse field applied, a coherent rotation model provides the best explanation of the experimental observations. The three regions can be demonstrated with a single sample in the case of the thin film.

538.2

8309. ON THE MAGNETIC AGING OF COMMERCIAL PURE IRON. M.Asanuma and S.Ogawa.

J. Phys. Soc. Japan, Vol. 12, No. 8, 955-8 (Aug., 1957).

The origin of magnetic ageing in commercial pure iron is clarified by means of magnetic initial susceptibility and internal friction. It is due to very small amounts of carbon and nitrogen in the iron, and the effect of nitrogen is greater than that of carbon and it is dominant especially in the period of formation of intermediate nitride.

538.2

8310. MAGNETIC ANNEALING IN PERMINVAR. I. STRUCTURAL ORIGIN. R.D.Heidenreich, E.A.Nesbitt and R.D.Burbank.

J. appl. Phys., Vol. 30, No. 7, 995-1000 (July, 1959).

Deals with the results of an electron diffraction investigation of the structure of soft magnetic materials which exhibit magnetic annealing. The property of heat treatment in a magnetic field has been found to depend upon the oxygen content present as an impurity and is associated with distinct diffraction phenomena. A structural model based on an interpretation of diffraction results, magnetic properties, and oxygen content is presented. The pertinent conclusions from this study are as follows. (1) The ability of soft magnetic alloys containing Fe, Co, and Ni to exhibit magnetic annealing properties is due to oxygen present as an impurity. (2) An oxygen content of about 0.001% is sufficient to produce magnetic annealing with the proper heat treatment. An alloy containing only 0.0001% oxygen fails to respond to field heat treatment or is "dead". (3) The oxygen impurity produces magnetic activity in the alloy crystal (with proper heat treatment) by condensing into the (111) planes of the crystal, thus giving rise to a stacking disorder of fault. The term "impurity fault" has been introduced to describe this structural irregularity. (4) The oxygen impurity faults are presently thought to be aligned by magnetic annealing and are intimately connected with field heat treatment properties. If sufficient oxygen is available in the crystal, the faults thicken and organize to yield metal oxides.

538.2

8311. MAGNETIC ANNEALING IN PERMINVAR. II. MAGNETIC PROPERTIES. E.A.Nesbitt and R.D.Heidenreich.

J. appl. Phys., Vol. 30, No. 7, 1000-003 (July, 1959).

Previous work on Alnico single crystals (permanent magnet alloy) showed that magnetic torque reversals are associated with an inhomogeneous structure. More recently, it has been found that alloys of iron, nickel, and cobalt in the Perminvar region also exhibit these torque reversals although the alloys are considered to be solid solutions. An inhomogeneous structure occurs simultaneously with the torque reversals in some of these alloys. The inhomogeneous structure has been observed by means of electron diffraction, and the observations have been interpreted to mean that there are faults in the lattice normal to [111] directions. The faults form in the temperature region where the magnetic field heat treatment is effective and their density is roughly proportional to the response of the magnetic field treatment. When the crystals are not heat treated in a field, the faults are arranged to have cubic symmetry and their magnetic anisotropy has cubic symmetry. When the crystals are heat treated in a magnetic field, electron diffraction indicates that the faults are usually affected also. Evidence has been obtained that small amounts of oxygen as an impurity in Perminvar cause both the faulting and the heat treatment in a magnetic field. An extremely small amount of oxygen (0.0014%) is sufficient to cause such effects. In a more detailed sense, it is felt that the magnetic anisotropy introduced by heat treatment in a magnetic field probably arises either from short range order within the faults or from the arrangements of the faults each of which is parallel to a (111) into regions whose shape anisotropy is along the direction of the magnetic field.

538.2

8312. SEARCH FOR NEW HEUSLER ALLOYS.

D.P.Morris, R.R.Preston and I.Williams.
Proc. Phys. Soc., Vol. 73, Pt 3, 520-3 (March, 1959).

Preliminary results are reported of X-ray and magnetic measurements for alloys corresponding to compositions Ag_2MnAl, Ag_2MnIn, Au_2MnAl, Au_2MnIn and Au_2MnZn. The silver compounds are not ferromagnetic down to liquid air temperature; Ag_2MnIn has a hexagonal crystal structure and Ag_2MnAl shows two phases after heat treatment. The gold alloys have a CsCl structure at room temperature. Au_2MnAl and Au_2MnIn are ferromagnetic with Curie temperatures at approximately −40°C and −130°C respectively. Au_2MnIn in addition suffers a cubic—tetragonal transformation at −37°C. Au_2MnZn preserves its cubic structure and paramagnetic properties down to liquid air temperatures. R.Parker

538.2 : 621.318.12

8313. SWITCHING TIMES OF A SQUARE-LOOP FERRITE.

R.Vautier and A.Marais.
C.R. Acad. Sci. (Paris), Vol. 248, No. 5, 660-3 (Feb. 2, 1959).
In French.

These were measured for symmetrically and asymmetrically applied fields, and the threshold fields related to the coercive force. E.P.Wohlfarth

538.2

8314. FERRITE SPECIMENS WITH TEMPERATURE INDEPENDENT GYROMAGNETIC PROPERTIES.

W.Haken and C. von Haza-Radlitz.
Arch. elekt. Ubertragung, Vol. 13, No. 4, 157-60 (April, 1959).
In German.

It is shown that the temperature variation of the gyromagnetic resonance frequency in a constant magnetic field, arising from the temperature variation of saturation magnetization, may be compensated by suitable specimen dimensions. These dimensions are calculated for ferrite strips in rectangular waveguides, and experimentally verified. A.J.Manuel

538.2

8315. INFLUENCE OF METHOD OF PREPARATION ON SOME MAGNETIC PROPERTIES OF A MANGANESE—ZINC FERRITE.

J.Brož, A.Bergstein, S.Krupička, J.Vintera and K.Závetă.
Czech. J. Phys., Vol. 7, No. 1, 66-79 (1957). In German.

Several Mn—Zn ferrite specimens containing excess Mn were prepared under different conditions of atmosphere (vacuum, air, nitrogen), temperature (950°-1300°C) and time of treatment (up to 3 hr). Magnetic properties measured include saturation magnetization, Curie temperature, g-factor and ferromagnetic resonance line width. See also Abstr. 8327 of 1959. E.P.Wohlfarth

538.2

8316. ON THE PROBLEM OF STUDYING THE IDEAL MAGNETIZATION INTENSITY OF MANGANESE FERRITE. J.Šternberk.

Czech. J. Phys., Vol. 7, No. 3, 339-43 (1957). In Russian.

It was shown experimentally that the ideal magnetization intensity of a toroid specimen can be measured by a modified version of the differential method first proposed by Chernikova (see Abstr. 7106 of 1951), in which one measuring coil only, wound uniformly on the toroid, is used, and that the effect of any irregularity of the winding can be eliminated by correct positioning of the toroid in the static magnetic field. M.H.Sloboda

538.2

8317. ON THE QUESTION OF THE INFLUENCE OF MAGNETIC INTERACTIONS ON THE INITIAL PERMEABILITY OF SINTERED FERRITES. J.Šternberk.

Czech. J. Phys., Vol. 7, No. 3, 372-4 (1957).

If the measured initial permeability is greater than that calculated from the rotation of the spontaneous magnetization vectors, it is usually concluded that boundary displacements also participate in the magnetization process. The author points out that magnetic interactions between crystal grains provide another possible explanation and shows that the properties of several ferrites are consistent with an equation derived from a simple model in which rotation occurs in grains assumed to lie inside spherical cavities surrounded by a medium with homogeneous magnetization. R.C.Kell

538.2

8318. STUDY OF ORIENTED POLYCRYSTALLINE FERRITES WITH CUBIC ANISOTROPY. C.F.Kooi, R.W.Moss and D.C.Stinson.

J. appl. Phys., Vol. 30, No. 6, 895-8 (June, 1959).

A study was made of crystallite orientation in cubic ferrites when pressed in a magnetic field. One easy axis orients in the field direction, the other easy axes lying at random in or near a perpendicular plane. Experimental torque curves have the theoretically predicted shape. The magnetic field required for microwave resonance is lower than in the same nonoriented ferrite if the axis of alignment and the field are parallel. This occurs because the anisotropy field H_a is no longer randomly oriented but helps to supply part of the resonant field requirement. Values of saturation magnetization (M_s), anisotropy energy (K), and resonant field (H_r) at 14 775 Mc/s were measured on a series of oriented polycrystalline nickel cobalt ferrites. Values of the measured resonant field are compared with values obtained from Kittel's resonance relation using the independently measured values of M_s and K.

538.2

8319. UNIAXIAL ANISOTROPY IN IRON—COBALT FERRITES.

S.Iida, H.Sekizawa and Y.Aiyama.
J. Phys. Soc. Japan, Vol. 13, No. 1, 58-71 (Jan., 1958).

The uniaxial anisotropy induced by the magnetic annealing in both single and polycrystals of iron—cobalt ferrites was studied experimentally. It is shown that the magnitudes of the uniaxial anisotropy depend essentially on the degree of oxidation of the specimens and become almost zero after deoxidizing heat treatments. Contrary to the conclusion by Bozorth et al., the dependence of the magnitude of the uniaxial anisotropy on the direction of the annealing magnetic field is observed for a cobalt rich single crystal, showing a maximum along <100> and a minimum along <110> in (001) plane. Relaxation behaviour of the uniaxial anisotropy is studied by measuring directly the change of torque at high temperatures (240°C~350°C) with a polycrystalline cobalt ferrite. It has been found that the results can be described by a simple empirical formula, supporting that the magnetic annealing effect has no critical temperature. The variation of electrical conductivity with temperature has also no anomaly at the effective temperature range. Considering all the experimental results obtained, the conclusion was reached that the uniaxial anisotropy in these ferrites is due to the presence of directional short range order among various cations and cation vacancies in the spine matrix. The nearest neighbour pair of a cobalt ion and a vacancy seems to play a principal role in this mechanism.

538.2

8320. VARIATION OF MAGNETIC PROPERTIES OF MIXED COPPER—NICKEL FERRITES AS A FUNCTION OF THE COPPER FERRITE/NICKEL FERRITE RATIO.

E.Lăbuşcă and F.Constantinescu.
Rev. de Physique (Bucarest), Vol. 3, No. 2, 141-50 (1958).
In German.

In the audiofrequency range NiZn ferrite has a low loss tangent (tan δ ~ 3×10^{-3}) and a low permeability (μ ~ 50), whereas CuZn ferrit has large losses (tan δ ~ 50) on account of its higher conductivity and a higher permeability (μ ~ 250). In an effort to produce a material which combines high permeability with low losses a number of mixed NiCuZn ferrites were made. Measurements of loss tangent and permeability as a function of magnetic field are reported for these materials at 10 kc/s. While some NiCuZn ferrites were practically nonmagnetic the others showed properties intermediate between those of NiZn ferrite and CuZn ferrite. The importance of heat treatment during manufacture is stressed but no details are given. R.Parke

538.

8321. RICHTER-TYPE MAGNETIC AFTER-EFFECT IN [NON-STOICHIOMETRIC] MANGANESE FERRITE.

S.Krupička and F.Vilím.
Czech. J. Phys., Vol. 7, No. 6, 723-8 (1957).

538.2 : 548.736.

MAGNETIC PROPERTIES OF THE CHROMIUM SULPHIDES.

See Abstr. 7652

538.2

8322. FERRIMAGNETISM IN THE SYSTEM $Na_2O-ZnO-Fe_2O_3$.

A.H.Mones and E.Banks.

J. Phys. Chem. Solids, Vol. 6, No. 2-3, 267-70 (Aug., 1958).

Mixtures of Na_2CO_3, ZnO, and Fe_2O_3 were fired at elevated temperatures in a flowing oxygen atmosphere. Most of the preparations resulted in single phases with the spinel structure, which were strongly magnetic. The intensity of magnetization of the materials could be accounted for on the basis of Neel's theory of ferrimagnetism. It was found that when K_2CO_3 was substituted for Na_2CO_3 a non-magnetic material resulted. MgO could be substituted for ZnO with the retention of strong magnetic properties.

538.2 : 548.736.5

8323. CRYSTALLOGRAPHIC AND MAGNETIC PROPERTIES OF SEVERAL SPINELS CONTAINING TRIVALENT JA-1044 MANGANESE.

D.G.Wickham and W.J.Croft.

J. Phys. Chem. Solids, Vol. 7, No. 4, 351-60 (Dec., 1958).

Many useful ferrimagnetic oxides which crystallize with the spinel structure contain several transition metals, each of which can exist in two or more possible oxidation states. A specific formulation for many such materials is very difficult. An approach to this problem, in some cases, can be made through crystallographic studies. The tetragonal distortion from cubic symmetry exhibited by several spinels containing manganese has been attributed to characteristic properties of Mn^{3+} ions occupying the octahedral positions in the lattice. Several new compositional systems containing manganese and crystallizing with the spinel structure have been prepared and studied crystallographically and magnetically. The following solid-solution systems were chosen because they appeared to present a minimum of ambiguity in composition and in the distribution of cations among tetrahedral and octahedral positions: $Zn_xGe_{1-x}Mn_2O_4$, $Zn_xGe_{1-x}Co_{2-2x}Mn_{2x}O_4$, and $Zn_xLi_{1-x}Mn_2O_4$. The tetragonal distortions from cubic symmetry observed for these systems can be accounted for by assuming that the octahedral sites are occupied by more than a critical fraction, 60-65 per cent, of Mn^{3+} ions. A complete range of solid solutions in the system $Co_{3-x}Mn_xO_4$ was prepared and formulae assigned to the basis of this rule. The configuration, for values of x between 0 and 2, appears to be $Co^{2+}[Co^{3+}_{2-x}Mn_x{}^{3+}]O_4$. The observed magnetic properties (saturation magnetization at 4.3° K and Curie temperatures) can be interpreted in terms of this configuration. The magnetization measured for cubic materials is the result of the Néel-type magnetic coupling between Co^{2+} ions on tetrahedral sites and Mn^{3+} ions on octahedral sites. Tetragonal materials apparently have a more complex magnetic structure. The configuration of $Co_{3-x}Mn_xO_4$ for values of x between 2 and 3 appears to be $Co^{2+}_{3-x}Mn^{2+}_{x-2}[Mn_2{}^{3+}]O_4$. The crystal-lattice constants, saturation magnetization (4.3° K) and Curie temperatures are given for a number of materials, including $GeMn_2O_4$, $LiMn_2O_4$, Co_3O_4, $MnCo_2O_4$, $CoMn_2O_4$ and Mn_3O_4.

538.2

8324. AN ISOTOPE EFFECT IN ANTIFERROMAGNETISM AT LOW TEMPERATURES.

J.M.Daniels.

Canad. J. Phys., Vol. 37, No. 1, 75-7 (Jan., 1959).

It is pointed out that the antiferromagnetic properties at low temperatures of hydrated salts are greatly influenced by the isotopic composition of the paramagnetic ions. This is so because the hyperfine coupling between unpaired electrons and the nuclear spins of paramagnetic ions may be much larger than the coupling between individual ions. For the case of $K_2InCl_5.2H_2O$ containing Mo^{5+} as an impurity it is calculated by a second-order perturbation method that the anisotropy field at absolute zero is 160 G larger for the odd molybdenum isotopes than for the even ones. For the case of $Sm(C_2H_5SO_4)_3.9H_2O$ the hyperfine interaction of the odd isotopes of samarium is estimated to be the dominant feature of the antiferromagnetic state. The examples quoted have isotropic g-factors and are thus not representative of magnetic substances generally. Significant differences in antiferromagnetic properties in materials containing different isotopes are also predicted for the general case.

R.Parker

538.2

8325. NEUTRON SCATTERING BY ANTIFERROMAGNETS ABOVE THE NÉEL POINT.

P.G.De Gennes.

J. Phys. Chem. Solids, Vol. 6, No. 1, 43-5 (July, 1958).

The general features of scattering in the elastic approximation are displayed by using the concept of a wavelength-dependent susceptibility. "Critical" scattering occurs above the Néel point, in the directions which would correspond, below the Néel point, to superlattice lines. The shape of the diffuse spots is given in terms of the Néel and paramagnetic Curie temperatures, for various types of lattices.

538.27

8326. FERROMAGNETIC RESONANCE IN CERTAIN Fe—Ni ALLOYS.

Z.Frait.

Czech. J. Phys., Vol. 7, No. 2, 246 (1957). In Russian.

Measurements of magnetic resonance parameters were made with specimens in the form of disks, the surfaces of which had been subjected to particularly careful polishing procedure. The apparatus and method have been given earlier (Abstr. 4805 of 1959). The nickel contents of the alloys were 79, 48 and 37% by weight respectively. It was found that for 3 cm waves the factor g varies little with alloy composition. The results generally were found in good agreement with those of Hoskins and Wiener (Abstr. 1052 of 1955).

C.R.S.Manders

538.27

8327. A CONTRIBUTION TO THE STUDY OF FERROMAGNETIC RESONANCE IN MANGANESE ZINC FERRITES.

S.Krupicka.

Czech. J. Phys., Vol. 7, No. 3, 344-50 (1957).

See also Abstr. 8315 of 1959. Ferromagnetic resonance experiments on three samples are reported, and the temperature variation given of the effective Landé factor g* and of the width ΔH of the resonance curve over the range −150° to 100° C. The temperature variation of the saturation magnetization M_s of the same three samples has been measured by Brož and Závěta [Czech. J. Phys., Vol. 7, 242 (1957)]. The variation of g* is discussed on the basis of an additional internal field $H_i = h\nu/(2\beta) - H_z$ and it appears that H_i and ΔH are determined by several common factors. It is found that Tsuya's model (Abstr. 1048 of 1955) for the production of H_i, in which $H_i \propto M_s$, is over-simplified.

D.M.Edwards

538.27

8328. FERROMAGNETIC RESONANCE IN POLYCRYSTALLINE FERRITES WITH LARGE ANISOTROPY. I. GENERAL THEORY AND APPLICATION TO CUBIC MATERIALS WITH A NEGATIVE ANISOTROPY CONSTANT.

E.Schlömann.

J. Phys. Chem. Solids, Vol. 6, No. 2-3, 257-66 (Aug., 1958).

If the anisotropy field is much larger than the single-crystal line width and the saturation magnetization, the shape of the resonance line is essentially determined by the spreading of resonance frequencies for different grains due to crystalline anisotropy. More precisely, if w(H)dH is proportional to the number of grains that have their resonance in the range of applied d.c. field between H and H + dH, the absorption versus field curve should be a smeared-out image of the distribution function w(H). The distribution function has characteristic singularities arising from the stationary points of the resonance field versus orientation surface. The behaviour of w(H) in the vicinity of the singularities is calculated for first-order cubic anisotropy, and w(H) is obtained by interpolation. For small anisotropy fields, the calculated line shape has a single peak which corresponds to grains in which a [110] direction is aligned with the d.c. field. For larger anisotropy fields ($\gamma H_a/\omega > 0.5$), a secondary peak occurs. It corresponds to grains in which an easy axis is aligned with the d.c. field. The theory accounts for secondary resonance peaks at low fields observed in ferrimagnetics near the compensation point.

538.27 : 621.375.9

8329. QUANTUM ANALOG OF THE FERROMAGNETIC MICROWAVE AMPLIFIER.

H.Suhl.

J. Phys. Chem. Solids, Vol. 4, No. 4, 278-82 (1958).

Certain resemblances between the modes of operation of the three-level maser and the ferromagnetic microwave amplifier are shown to be superficial by constructing a quantum-mechanical model of the latter device. It is shown that while establishment of a negative temperature for two levels is essential in the three-level maser, it is inessential in the analogue of the ferromagnetic amplifier, which in essence depends only on the time-varying part of the density matrix.

538.27

8330. ANOMALOUS SKIN EFFECT IN FERROMAGNETICS.

V.L.Gurevich.

Zh. tekh. Fiz., Vol. 28, No. 10, 2352-4 (1958). In Russian.

The problem of anomalous skin effect under the conditions of ferromagnetic resonance is analysed by solving a set of equations consisting of the system of Maxwell's equations, the kinetic equation for the conduction electrons, and the Landau–Lifshits equation of motion for the vector of the intensity of magnetization.

M.H.Sloboda

538.27

8331. SPECTROMETER FOR ELECTRON PARAMAGNETIC RESONANCE: INFLUENCE OF THE AMPLITUDE OF THE MAGNETIC FIELD MODULATION ON THE FORM OF THE LINE OBTAINED BY SYNCHRONOUS DETECTION. J.Roch.
C.R. Acad. Sci. (Paris), Vol. 248, No. 5, 663-6 (Feb. 2, 1959).
In French.

A theoretical and experimental analysis is given of the influence of amplitude of magnetic field modulation on the magnitude and width of a resonance line observed on a spectrometer with a synchronous detector at the modulation frequency. The author shows how to correct for the systematic error produced in the line width, and estimates the optimum conditions for the detection of weak signals.

J.M.Baker

538.27

8332. MICROWAVE SPECTROMETER TESTS ELECTRON RESONANCE. R.R.Unterberger.
Electronics, Vol. 32, No. 11, 142-4 (March 13, 1959).

Describes in detail a microwave system for the accurate measurement of paramagnetic resonance in solids and liquids.

R.C.Glass

538.27

8333. $O^{16}O^{18}$ MOLECULES AS INTENSITY STANDARDS IN ELECTRON SPIN RESONANCE SPECTROSCOPY.
G.Filipovich and T.M.Sanders,Jr.
Rev. sci. Instrum., Vol. 30, No. 4, 293-4 (April, 1959).

The authors propose the use of gaseous $O^{16}O^{18}$ as an intensity standard in e.s.r. spectroscopy. The advantages and disadvantages of this standard are discussed and typical results on the authors' spectrometer are quoted.

J.M.Baker

538.27

8334. MAGNETIC ABSORPTION PHENOMENA IN GERMANIUM AT LOW TEMPERATURES.
L.van Gerven, A.van Itterbeek and L.de Laet.
Appl. sci. Res. B, Vol. 7, No. 5, 345-54 (1959).

Some magnetic absorption phenomena were found and investigated in Sb-doped germanium at low temperatures, using relatively low radio frequencies (20 to 100 Mc/s). Two different absorption lines were observed. They differ by the sign of their top and by the temperature region where they occur. One of the lines is single-valued, but the other is multi-valued and shows some kind of hysteresis. Their properties and possible origins are discussed.

538.27

8335. PARAMAGNETIC RESONANCE OF METHYL- AND CHLORO-SUBSTITUTED p-BENZOSEMIQUINONES.
B.Venkataraman, B.G.Segal and G.K.Fraenkel.
J. chem. Phys., Vol. 30, No. 4, 1006-16 (April, 1959).

Detailed measurements were made, under conditions of high resolution, of the paramagnetic resonance spectra of the negative radical ions of all the methyl- and chloro-substituted p-benzosemiquinones. All the spectra exhibited hyperfine structure which is accounted for in terms of interactions between the unpaired electron and all the protons in the radicals; no chlorine hyperfine splittings were observed. In some of the chlorine compounds anomalous lines, not attributable to the chloro-substituted p-benzosemiquinone ion appeared; these presumably arise from radicals produced by side reactions. Microwave power saturation was encountered in all the spectra examined. Line widths of all the spectra were observed to depend markedly on the microwave power and on the concentration of the hydroquinone from which the semiquinone was prepared. Separations of the hyperfine components were measured to a high degree of accuracy and splitting constants for individual protons were calculated from the measurements using the method of least squares. Proton splitting constants ranged from a minimum of 1.714 gauss for the methyl group protons in 2,3-dimethyl semiquinone ion to a maximum of 2.595 gauss for the ring protons in that same compound. The variation of the splitting constants with chlorine and methyl group substitutions are shown to obey a nearly additive relation.

538.27

8336. MAGNETIC INTERACTION OF H_3.
V.Griffing, J.L.Jackson and B.J.Ransil.
J. chem. Phys., Vol. 30, No. 4, 1066-74 (April, 1959).

The results of an LCAO-MO-SCF-CI calculation of the $^2\Sigma_u$ ground state of linear H_3 are presented and the wave functions obtained from this calculation are used to calculate the general features of the electron spin resonance spectrum. The calculation is carried through for the Fermi contact interaction, which is the principal interaction between the proton and electron spins. It is found that the off-diagonal elements of the hyperfine interaction matrix may not be neglected in that they split degenerate levels. The predicted spectrum, however, does not agree with the observed electron spin resonance spectrum of discharged hydrogen deposited at liquid helium temperatures. In addition the expected electron spin resonance spectrum of H_2^+ has been calculated from the exact wave function.

538.27

8337. PARAMAGNETIC RESONANCE SPECTRUM OF THE FLUOROFERRATE ION, FeF_6^{---}. L.Helmholz.
J. chem. Phys., Vol. 31, No. 1, 172-5 (July, 1959).

The fluorine hyperfine structure in the paramagnetic resonance spectrum of this ion has been observed in a solid solution of the ion in K_2NaGaF_6. From the isotropic and anisotropic components of the spectrum the magnitudes of the coefficients of the fluorine atomic orbitals in the molecular orbitals occupied by the unpaired electrons are estimated. The results are compared with results on Mn^{++} dissolved in other fluorides. The antibonding e_g orbitals are found to contain about 2.5% fluorine 2s orbital and approximately 10% fluorine 2p orbital.

538.27

8338. PARAMAGNETIC RESONANCE ABSORPTION IN CHROMOUS SULPHATE PENTAHYDRATE. K.Ôno.
J. Phys. Soc. Japan, Vol. 12, No. 11, 1231-8 (Nov., 1957).

The resonance spectra were analysed at room temperature for the wavelengths between 0.54 and 1.1 cm. The results show that this crystal has a structure similar to that of copper sulphate pentahydrate. The data were analysed by the spin Hamiltonian and the positions and intensities of the absorption lines are adequately explained by a crystalline electric field of rhombic symmetry. The parameters determined are quite consistent with the values of the spin—orbit coupling constant and spin—spin interaction constant obtained from spectroscopic data. The line-width varies from 1 to 3 kOe with the direction of the magnetic field and high frequency field, and seems to be broader than that expected from magnetic dipolar interaction alone.

538.27

8339. PARAMAGNETIC RESONANCE IN COPPER ACETATE MONOHYDRATE. H.Abe and J.Shimada.
J. Phys. Soc. Japan, Vol. 12, No. 11, 1255-8 (Nov., 1957).

At four microwave frequency bands (λ = 78, 10, 16 and 32 mm), single crystals of copper acetate monohydrate, $Cu(CH_3COO)_2H_2O$, were examined at room temperature by the method of paramagnetic resonance absorption. The results differing somewhat from those of usual copper salts. They can be explained by a spin-Hamiltonian with an effective spin S = 1 which is considered to be originated from a pair of Cu^{++} ions each in ^2D state, holding a strong interaction between them. This is consistent with the results of X-ray crystallography; the crystal consists of bimolecular units $Cu_2(CH_3COO)_4{\cdot}2H_2O$, in which two copper ions approach as close as 2.64 A. Exchange energy between these copper ions in the unit was estimated using the parameters determined from the resonance spectra and its temperature dependence is discussed.

538.27

8340. ELECTRON SPIN RESONANCE OF M CENTERS IN POTASSIUM CHLORIDE. H.Kawamura and K.Ishiwatari.
J. Phys. Soc. Japan, Vol. 13, No. 1, 33-6 (Jan., 1958).

An experiment on the electron spin resonance of coloured KCl containing F and M centres was performed at 9500 Mc/s. Subtracting the contribution from the F centres from the observed resonance curve, the shape of the resonance line due to M centres alone was estimated, and was found to be Gaussian with a half-breadth of 48 Oe and g value of 2000. This result is discussed on the LCAO model.

538.27 : 539.2

8341. PARAMAGNETIC RESONANCE ABSORPTION OF A V CENTER IN LiF. T.O.Woodruff and W.Känzig.
J. Phys. Chem. Solids, Vol. 5, No. 4, 268-87 (1958).

By X-irradiation of LiF at liquid-nitrogen temperature, an electron-deficiency centre is created that can be described as a F_2^- molecule-ion, as was shown in previous work by Castner and Känzig [J. Phys. Chem. Solids, Vol. 3, 178 (1957)]. The present paper contains a more rigorous and complete study of the paramagnetic resonance absorption spectrum of this centre. The spin energy matrix based on the spin Hamiltonian proposed in the previous paper has been diagonalized, and it is shown that the "allowed" and "forbidden" transitions between the resulting energy levels are in good agreement with the observed paramagnetic resonance lines, for any orientation of the crystal in the d.c. magnetic field.

538.27

8342. PARAMAGNETIC-RESONANCE SPECTRUM OF GADOLINIUM IN SINGLE CRYSTALS OF THORIUM OXIDE.

W.Low and D.Shaltiel.
J. Phys. Chem. Solids, Vol. 6, No. 4, 315-23 (Sept., 1958).

The paramagnetic-resonance spectrum of single crystals of ThO_2 containing less than 0.01 mol per cent of Gd^{3+} has been analysed at 290° and 90°K at 3 cm wavelength. The positions and intensities of the lines are explained by a crystalline field of cubic symmetry. The ground state is split with an overall separation $8c-2d = 0.1755 \pm 0.0003\ \mathrm{cm}^{-1}$, $c = 219.9 \pm 0.3 \times 10^{-4}\ \mathrm{cm}^{-1}$, $d = 1.0 \pm 0.3 \times 10^{-4}\ \mathrm{cm}^{-1}$, $g = 1.9913 \pm 0.0005$ at 290°K; and $8c-2d = 0.1796 \pm 0.0008\ \mathrm{cm}^{-1}$, $c = 225.0 \pm 0.8 \times 10^{-4}\ \mathrm{cm}^{-1}$, $d = 1.7 \pm 0.8 \times 10^{-4}\ \mathrm{cm}^{-1}$, $g = 1.991 \pm 0.001$ at $T = 90^0$K. Transitions corresponding $\Delta M = \pm 3$, $\Delta M = \pm 4$, $\Delta M = \pm 5$ were observed. The narrow line width of less than 1 G permits the detection of the hyperfine structure of the two isotopes 155 and 157. The ratio of the magnetic moments is $\mu_I^{155}/\mu_I^{157} = 0.744 \pm 0.007$ and the spectra are consistent with nuclear spins of $\frac{3}{2}$ for both isotopes. It is suggested that there are oxygen vacancies distributed at random throughout the crystal.

538.27 : 537.311.33

8343. SPIN RESONANCE OF DONORS IN CdS.

J.Lambe and C.Kikuchi.
J. Phys. Chem. Solids, Vol. 8, 492-4, 506 (Jan., 1959).

Rochester Semiconductors Conference Paper (see Abstr. 4569/1959). A single spin resonance line with an anisotropic g factor was observed at 4°K in a single crystal of CdS doped with chlorine to give a carrier concentration of 10^{17} electrons cm^{-3}. The results are discussed qualitatively. A.J.Manuel

538.27

8344. RADIATION DAMPING EFFECTS IN TWO LEVEL MASER OSCILLATORS.

A.Yariv, J.R.Singer and J.Kemp.
J. appl. Phys., Vol. 30, No. 2, 265 (Feb., 1959).

Experimenters have noticed amplitude modulation occurs when a two-level spin system radiates spontaneously. Inadequacies of previous explanations are pointed out and it is suggested that the answer lies in the non-linear solution of the equations of motion, wherein the magnetization M_Z is allowed to vary with time.
D.Walsh

538.27 : 621.375.9

8345. SUSCEPTIBILITY OF THE THREE-LEVEL MASER.

A.M.Clogston.
J. Phys. Chem. Solids, Vol. 4, No. 4, 271-7 (1958).

The quantum-mechanical equations of motion of a three-level maser, including the off-diagonal terms are solved approximately to obtain the susceptibility χ presented by the paramagnetic material at the frequency $(1/h)(E_3-E_2)$. The effect of the cavity reaction at the frequency $(1/h)(E_2-E_1)$ is considered. The line shape is shown to be drastically altered for large-amplitude driving fields.

538.27

8346. A NUCLEAR MAGNETIC RESONANCE MASER IN WEAK FIELDS.

H.Benoit, P.Grivet and H.Ottavi.
C.R. Acad. Sci. (Paris), Vol. 247, No. 22, 1985-8 (Dec. 1, 1
In French.

Benzene flows into a chamber situated in a 7500 gauss magnet and then flows though an exciting coil situated in the fringe field, and, after a passage time of two seconds or, through another pipe, of 5.6 sec, reaches a detecting coil with its damping reduced by an electronic negative resistance device. With this apparatus maser oscillations can be observed in the second coil. The starting condition predicted by Townes was verified and the relaxation time T_1 of benzene was measured. A value of about 3 sec was measured. It was concluded that the liquid had been contaminated by rubber tubes etc. since the "spin—lattice" relaxation time of benzene is known to be 19 sec. H.Motz

538.27

8347. STUDY OF AN AUTO-OSCILLATOR OF THE MASER TYPE IN A WEAK FIELD.

H.Benoit, P.Grivet and H.Ottavi.
C.R. Acad. Sci. (Paris), Vol. 248, No. 2, 220-3 (Jan. 12, 1959).
In French.

With the experimental set-up described in the preceding abstract the effect of the polarization and the quantity of benzene on the maser output in a weak field were studied. The frequency pulling by the tuning of the maser coil was measured as a function of the circuit Q. It was found to increase slightly with quantity of liquid streaming through per unit of time. H.Motz

538.27 : 538.7

8348. MEASUREMENT OF THE EARTH'S MAGNETIC FIELD BY A NUCLEAR MAGNETIC RESONANCE MASER.

H.Benoit and J.Hennequin.
C.R. Acad. Sci. (Paris), Vol. 248, No. 13, 1991-3 (April 1, 1959).
In French.

The maser used for these measurements is similar to one described in the preceding abstracts. The apparatus is sufficiently sensitive for measurements of weak fields even in the laboratory.
J.M.Baker

538.27

8349. RUBY AS A MASER MATERIAL.

C.Kikuchi, J.Lambe, G.Makhov and R.W.Terhune.
J. appl. Phys., Vol. 30, No. 7, 1061-7 (July, 1959).

The reasons for the initial choice of ruby as a maser material are outlined and some measurements of the parameters in the spin Hamiltonian and of spin relaxation times are reported. The relative merits of single- and double-pump modes of operation of a four-sided maser are discussed and measurements of the oscillator power for the two cases are included.

538.27

8350. METHOD FOR CALCULATING SIMULTANEOUS RESONANCE CONDITIONS IN A THREE-LEVEL RUBY MASER.

M.A.Garstens.
J. appl. Phys., Vol. 30, No. 7, 976-7 (July, 1959).

In operating a three-level maser one wishes to know the external magnetic field and crystal orientation necessary to match a given pair of frequencies. In the case of Cr^{+++} a fourth-degree secular equation determines four energy levels for each value of external field H and crystal orientation θ. Determination of the latter two variables, given two desired frequencies of operation, ordinarily involves either the solution of a tremendous number of fourth-degree equations and extrapolation towards the required solution, or determination of the matching conditions by experimental methods. A method is described allowing direct calculation of H and θ for a three-level ruby maser.

538.27

8351. A NUCLEAR INDUCTION SPIN-ECHO APPARATUS.

B.M.Banerjee, S.K.Ghosh and A.K.Saha.
Indian J. Phys., Vol. 31, No. 4, 211-26 (April, 1957).

A very flexible apparatus with Bloch's crossed-coil probe for the detection of spin-echo signals is described in detail. A fixed 1 Mc/s master oscillator allows the frequency of the final gated amplifier to be set at different values by proper selection of the harmonic in the harmonic generators. The pulse generators produce a sequence of pulses, the number, durations, intervals and repetition rates of which can be adjusted independently. Using Hahn's method, both the spin—lattice relaxation time T_1 and the spin—spin relaxation time T_2 were measured for protons in glycerine.

538.27

8352. SPIN ECHOES WITH FOUR AND MORE PULSES.

T.Ghose, S.K.Ghosh and D.K.Roy.
Indian J. Phys., Vol. 31, No. 5, 265-77 (May, 1957).

The vector model developed by Banerjee et al. (see preceding abstract) for explaining the primary, secondary and stimulated echoes is here applied to the explanation of the "virtual" echo. The model also explains the formation — with positions and relative magnitudes — of all the echoes arising from the four pulse system, including the "quarternary" echo. In fact, this model shows that with any number of pulses, the resulting echoes can always be explained by the primary, stimulated and virtual echo mechanisms. A tentative explanation of the formation of series echoes with double-pulse system, when the sample is not allowed to come to thermal equilibrium, is also given.

538.27

8353. MOLECULAR TRANSFER OF NONEQUILIBRIUM NUCLEAR SPIN MAGNETIZATION. H.M.McConnell and D.D.Thompson.
J. chem. Phys., Vol. 31, No. 1, 85-8 (July, 1959).

A new magnetic resonance technique has been developed to measure the rates of fast molecular processes. The method involves the experimental introduction of a nonequilibrium nuclear magnetization in one system A, and the subsequent measurement of the rate at which rapid molecular processes transfer this nonequilibrium magnetization to a second system B. Systems A and B may correspond to different chemical sites in a molecule that give rise to a chemical shift, or to sites that are distinct because of electron coupled spin—spin interaction. This technique has been applied to determinations of the rate of proton exchange between ammonium ions in aqueous solution.

538.27

8354. CROSS-RELAXATION IN SPIN SYSTEMS.
N.Bloembergen, S.Shapiro, P.S.Pershan and J.O.Artman.
Phys. Rev., Vol. 114, No. 2, 445-59 (April 15, 1959).

The energy transfer between adjacent resonances in nuclear and electron spin systems is analysed in terms of the overlap of line-shape functions. The procedure is an enlargement on the original proposal of Kronig and Bouwkamp, and consists of taking partial account of off-diagonal elements in the spin—spin interaction, which are omitted in Van Vleck's truncated Hamiltonian. If the frequency of these off-diagonal elements is sufficiently small, they give rise to an additional kind of spin—spin relaxation, observed by Gorter and co-workers. They are also responsible for cross-saturation effects in paramagnetic salts of the type observed by Townes and co-workers. A crucial experiment is described which can be explained by spin—spin interactions, but not by the assumption of a hot-phonon region. Implications of the cross-relaxation for the operation of solid state masers are discussed. Special consideration is given to magnetically dilute substances and inhomogeneously broadened lines. Paradoxically, the latter will usually still undergo a homogeneous steady-state saturation.

538.27

8355. A NUCLEAR RESONANCE SPECTROGRAPH WITH IMPROVED RESOLUTION. I. THEORY OF LINE DISTORTION IN HIGH RESOLUTION NUCLEAR RESONANCE SPECTROSCOPY.
H.Primas.
Helv. phys. Acta, Vol. 30, No. 4, 297-314 (1957). In German.

The distortion of resonance signals due to spatial inhomogeneities and stochastic time variations of the magnetic field are considered. The permissible field variations for a given resolution are specified and a discussion of measuring techniques for smallest signal distortion is given. A.J.Manuel

538.27

8356. A NUCLEAR RESONANCE SPECTROGRAPH WITH IMPROVED RESOLUTION. II. DESCRIPTION OF THE APPARATUS.
H.Primas and H.H.Günthard.
Helv. phys. Acta, Vol. 30, No. 4, 315-30 (1957). In German.

A complete nuclear induction apparatus with a resolving power of 10^8 is described. A.J.Manuel

538.27 : 538.1

PRODUCTION OF VERY HOMOGENEOUS MAGNETIC FIELDS FOR HIGH-RESOLUTION NUCLEAR RESONANCE STUDIES.
See Abstr. 8277

538.27

8357. NARROWING EFFECT IN NUCLEAR MAGNETIC DOUBLE RESONANCE IN SOLIDS. Y.Saito.
J. Phys. Soc. Japan, Vol. 13, No. 1, 72-8 (Jan., 1958).

Experiments on nuclear magnetic double resonance were performed in several ionic crystals of type AB where the resonance behaviour of the A-spin was investigated under the irradiation of strong r.f. field resonating to the B-spin. At the strongest r.f. field used, narrowing of the line width was observed and this fact showed evidently that the local field at the position of A-spin originating from B-spin was averaged out to zero. By using this principle the origin of the anomalously broad line width in TlBr crystal was pursued. The experimental results supported the suggestion that the broad line width would be attributable to the indirect nuclear spin—spin coupling. The second moment of the line width in double resonance calculated by the use of a rotating coordinate system was in agreement with the experimental value.

538.27

8358. NUCLEAR RELAXATION IN IONIC CRYSTALS.
P.G.De Gennes.
J. Phys. Chem. Solids, Vol. 7, No. 4, 345-50 (Dec., 1958).
In French.

It is shown that where nuclear relaxation is due to paramagnetic impurities, the part of the total nuclear magnetization that is parallel to the static field obeys a simple relaxation equation. The inverse relaxation time is proportional to: (a) the impurity concentration; (b) the spin diffusion coefficient; and (c) a "relaxation length", a, whose exact value depends on the behaviour of the nuclear spins in the near vicinity of the paramagnetic impurities. The relaxation rates are modified if the impurities are grouped in clusters or on dislocation lines.

538.27

8359. TRANSISTORIZED NUCLEAR RESONANCE MAGNETIC FIELD PROBE. J.R.Singer and S.D.Johnson.
Rev. sci. Instrum., Vol. 30, No. 2, 92-3 (Feb., 1959).

A transistorized marginal oscillator type of nuclear resonance probe is described. The main advantages of transistor use are in obtaining portability, eliminating external power sources, and low cost. The sensitivity and stability equalled that of a standard transitron vacuum tube circuit when compared using protons in water.

538.27

8360. PROTON NMR SPECTRA OF HYDRATED CATIONS.
R.C.Axtmann.
J. chem. Phys., Vol. 30, No. 1, 340-1 (Jan., 1959).

The proton spectra of aqueous solutions of eleven nitrates have been determined. A straight line correlation is obtained on plotting the molar chemical shifts relative to water against the pK_a of the cations. G.I.W.Llewelyn

538.27

8361. PROTON MAGNETIC RESONANCE AND ELECTRON SPIN DENSITIES OF HYDRAZYL.
H.S.Gutowsky, H.Kusumoto, T.H.Brown and D.H.Anderson.
J. chem. Phys., Vol. 30, No. 3, 860-1 (March, 1959).

Proton magnetic resonance in polycrystalline α,α-diphenyl β-picryl hydrazyl at 26.9 Mc/s and 77°K shows a line shape which comprises two partially resolved components of equal intensity but different widths. A calculation of the electron spin density at the different proton positions in the molecule has been made; the chemical shifts observed, particularly their ratio, agree with the interpretation that one component is due to negative spin density at the meta position and the other is due to positive spin density at the ortho and para positions. J.M.Baker

538.27

8362. TEMPERATURE DEPENDENCE OF PROTON RELAXATION TIMES IN AQUEOUS SOLUTIONS OF PARAMAGNETIC IONS.
R.A.Bernheim, T.H.Brown, H.S.Gutowsky and D.E.Woessner.
J. chem. Phys., Vol. 30, No. 4, 950-6 (April, 1959).

The nuclear magnetic relaxation times of protons in aqueous solutions of paramagnetic ions were measured as a function of temperature. For Mn^{++} ions, the proton T_1 and T_2 were measured at 10, 20, and 38 Mc/s, and for Co^{++}, Cu^{++}, and Gd^{+++} ions, 20 Mc/s. The temperature effects observed can be explained by incorporating the proper temperature dependences of the several correlation times into the general Bloembergen—Solomon relaxation expressions. In the case of Mn^{++} solutions, which have a T_1/T_2 ratio of about 5.5 at room temperature and 20 Mc/s, chemical as well as electron exchange and dipolar interactions are found to be important. Analysis of the data by means of the equations developed provides information concerning the chemical exchange of solvent protons with those in the hydrated Mn^{++} ion. An activation energy of 8.4 kcal/mole and other parameters for this process are evaluated. The temperature dependence of T_1 and T_2 in the Co^{++}, Cu^{++}, and Gd^{+++} solutions can be explained by the temperature dependence of the dipolar interaction alone. Varying the anion in Cu^{++} solutions had little effect on T_1 or its temperature dependence; also, T_1 for Cu^{++} solutions was found to vary inversely with concentration over the whole temperature range studied.

538.27

8363. PROTON MAGNETIC RESONANCE STUDY OF THE STRUCTURE OF POTASSIUM PENTABORATE.
A.A.Silvidi and J.W.McGrath.
J. chem. Phys., Vol. 30, No. 4, 1028-31 (April, 1959).

The proton magnetic resonance absorption spectrum of monocrystalline potassium pentaborate was measured at room temperatur using a Pound—Watkins spectrometer. The results indicate that there are two waters of hydration per molecule. The interproton distance is 1.60 ± 0.02 A. The p—p axes lie in the b—c plane of the crystal and make an angle of 93° ± 4° with each other. Using experimental data together with consideration of interatomic distances and hydrogen bonding, the remaining hydrogens are tentatively located in the molecule.

538.27 : 541.124

8364. PROTON MAGNETIC RESONANCE IN THE MIXTURES OF ANILINE AND N-ALKYLATED ANILINES WITH GLACIAL ACETIC ACID.

T.Isobe, T.Ikenoue and G.Hazato.

J. chem. Phys., Vol. 30, No. 5, 1371-2 (May, 1959).

Two-component systems in which the ring substituents interact with acid have been studied. G.I.W.Llewelyn

538.27

8365. MEASUREMENT AND INTERPRETATION OF THE TEMPERATURE DEPENDENCE OF THE PROTON MAGNETIC RESONANCE RELAXATION TIMES OF SOLUTIONS OF IONS OF THE FIRST TRANSITION GROUP IN WATER.

R.Hausser and G.Laukien.

Z. Phys., Vol. 153, No. 4, 394-411 (1959). In German.

An investigation of the temperature dependence (0°C to 90°C) of the proton magnetic resonance relaxation times, T_1 and T_2 in water solutions of paramagnetic ions of the transition metals (concentrations of order 10^{20} ions for cm^3) and in particular the values of T_1/T_2. T_1/T_2 may differ substantially from unity and may be ten or more. This cannot be due to direct nuclear-dipole—electronic-dipole interaction but is explicable in terms of a Fermi type ($\underline{I}.\underline{S}$) interaction modified by thermal motion (τ_C) and dependent on the electronic spin relaxation time (τ_S). The result depends in a rather complex manner on the relative magnitudes of τ_C, τ_S, and ω_S, the spin resonance frequency. A qualitatively satisfactory interpretation of the experimental results is obtained. J.G.Powles

538.27

8366. PROTON MAGNETIC RESONANCE OF THE CH_3 GROUP. V. TEMPERATURE DEPENDENCE OF T_1 IN SEVERAL MOLECULAR CRYSTALS.

E.O.Stejskal, D.E.Woessner, T.C.Farrar and H.S.Gutowsky.

J. chem. Phys., Vol. 31, No. 1, 55-65 (July, 1959).

For Pt IV, see Abstr. 744 of 1959. The proton T_1 was observed by r.f. pulse techniques in acetonitrile, neopentane, *t*-butyl chloride, 2,2-dichloropropane, and methyl chloroform from their melting points to temperatures about −150°C. Activation energies of 5 to 6 kcal/mole were obtained for self-diffusion in the high-temperature solid phase of neopentane, *t*-butyl chloride, and 2,2-dichloropropane. Activation energies ranging from 1 to 4.5 kcal/mole were obtained for molecular tumbling and from 3 to 4 kcal/mole for CH_3 group reorientation in the series of tetrasubstituted methanes, neopentane to methyl chloroform. The effects of intermolecular forces on CH_3 group reorientation are shown by the activation energy of 2.1 kcal/mole found for acetonitrile, which as no internal barrier. The various results confirm that a tunnelling mechanism is plausible for the CH_3 group reorientations. Other results include: the Bloch decay after a 90° pulse in solid methyl chloroform has a "slow beat" which is the Fourier transform of the triplet line shape found in steady-state experiments. The dependence of T_1 upon resonance frequency in the low-temperature phase of methyl chloroform exhibits systematic effects attributable to proton-chlorine spin exchange induced by reorientations of the CCl_3 group. The T_1 is constant in the supercooled high-temperature solid phase of methyl chloroform. There is an anomalous increase in the T_1 at the low-temperature transition in *t*-butyl chloride, indicating a higher molecular mobility during the phase transition than in either stable solid phase. A 2 : 1 mixture of CH_2DCCl_3 and CH_3CCl_3 gave proton T_1 values only 1.3 to 1.6 times as long as those in normal CH_3CCl_3, whereas the tunnelling mechanism suggests a 20-fold increase. Spin exchange between protons in neighbouring CH_2DCCl_3 and CH_3CCl_3 molecules accounts for the results and it is proposed that spin exchange may be investigated directly by observing T_1 in appropriate isotopic mixtures of known composition.

538.27

8367. STRONG COUPLING IN NUCLEAR RESONANCE SPECTRA. I. THE FIVE-SPIN SYSTEM OF TRANS-PROPENYLBENZENE.

R.W.Fessenden and J.S.Waugh.

J. chem. Phys., Vol. 30, No. 4, 944-9 (April, 1959).

Energy levels and allowed transitions are calculated for a system of five spin-$\frac{1}{2}$ particles of the type ABX_3. An extension to the ABC_3 is made by perturbation theory. The results are applied to an analysis of the proton resonance spectrum of trans-propenylbenzene, and it is found that at least one spin—spin coupling constant is negative. An "anomalous" spectrum previously reported, which shows superficial resemblances to the one studied here, is explained by assuming the presence of an impurity.

538.27

8368. NUCLEAR MAGNETIC RESONANCE STUDY OF BORON CARBIDE.

A.H.Silver and P.J.Bray.

J. chem. Phys., Vol. 31, No. 1, 247-53 (July, 1959).

Powdered and single crystal samples were used. The resonance patterns for B^{11} were observed at several Larmor frequencies from 5.53 to 17.7 Mc/s. Analyses of the spectra with the application of the quadrupole interaction show that there are three crystallographically nonequivalent boron positions, contrasted with the two positions given by X-ray structure determinations. Estimated quadrupole coupling constants for the $6h_1$ and $6h_2$ positions are given. The third position is assigned to 1b, previously believed to be occupied by carbon atoms. In the 1b positions, the quadrupole coupling constant of the B^{11} nuclei is 5.58 ± 0.02 Mc/s. Large variations in the width and shape of the resonance from the 1b atoms are explained by the presence of many small angle grains in the single crystal which produce variations in orientations of the local principal axis systems.

538.27

8369. THE PRESSURE DEPENDENCE OF THE KNIGHT SHIFT IN THE ALKALI METALS AND COPPER.

G.B.Benedek and T.Kushida.

J. Phys. Chem. Solids, Vol. 5, No. 4, 241-55 (1958).

Measurements on lithium, sodium, rubidium, caesium, copper, and aluminium have been made at room temperature in the pressure range 1-10 000 kg/cm². The volume-dependence of $\langle|\psi_F(0)|^2\rangle \equiv P_F$ has been deduced from these data, using Pines' collective electron picture for the paramagnetic susceptibility of the conduction electrons. The results of recent calculations of the volume-dependence of P_F are presented and compared with the experimentally deduced results. The Knight shift is shown experimentally to be an explicit function of the temperature at constant volume. A theory, which takes into account semiquantitatively the effect of the lattice vibrations on P_F, is proposed. Comparison is made between this theory and the experimental observations.

538.27

8370. PURE QUADRUPOLE RESONANCE DETERMINATIONS OF MOLECULAR CHARGE DISTRIBUTIONS. II. SUBSTITUTED PYRIMIDINES.

H.O.Hooper and P.J.Bray.

J. chem. Phys., Vol. 30, No. 4, 957-61 (April, 1959).

For Pt I, see Abstr. 9092 (1958). The amount of double-bond character of the carbon—chlorine bond at the 2, 4, and 6 positions in twelve substituted chloropyrimidines was estimated from the chlorine pure quadrupole resonance frequencies. If it is assumed that the nitrogens have a weak inductive effect upon the adjacent ring positions, then the calculated values for the amount of double-bond character agree quite well with data obtained from experiments employing Zeeman splitting techniques applied to pure quadrupole resonance spectra.

538.27

8371. NUCLEAR QUADRUPOLE RESONANCE OF ANTIMONY ISOTOPES IN SOLIDS.

S.Ogawa.

J. Phys. Soc. Japan, Vol. 12, No. 10, 1105-10 (Oct., 1957).

Measurements were made at a relative accuracy of about $1:10^6$. The detectors were superregenerative oscillators. Relative accuracy was achieved by measurement of two or three resonance frequencies in a very short time. For antimony trichloride the results were almost in agreement with Wang's data, but the resonant frequency ν_3 of the Sb^{123} isotope was higher about 2.5 kc/s. This implies that the cedecipole coupling constant might not have an order of magnitude which leads to a definitely measurable amount. In antimony oxide the simultaneous measurement was easier, since it has a small asymmetry parameter. In this case, the deviation of resonance frequencies from a multiple relation is very small. These results are discussed in terms of cedecipole interaction and thermal vibration.

538.27

8372. STRUCTURE OF NUCLEAR QUADRUPOLE RESONANCE LINE. II. SOLID BROMINE.

S.Kojima, Y.Abe, M.Minematsu, K.Tsukada and A.Shimauchi.

J. Phys. Soc. Japan, Vol. 12, No. 11, 1225-31 (Nov., 1957).

For Pt I, see Abstr. 628 (1957). Broad resonance lines of

Br^{79} and Br^{81} in a single crystal of bromine were studied. If the theory of indirect spin—spin coupling is applied, ten components are expected for each lines even when asymmetry of the field gradient tensor is neglected. The observed derivative curves of the lines could not be resolved into more than three lines. Provided that the each component has a finite line-width a rough agreement was obtained with the interaction constant of 3 kc/s. This value is reasonable if the s-character of the Br—Br bond is 18%. The ratio between overall line-width of Br^{79} and Br^{81} accorded approximately with the ratio of the square of nuclear magnetic moment.

ELECTROMAGNETISM

MAGNETOHYDRODYNAMICS

538.3 : 532.5

8373. ON THE STABILITY OF FORCE-FREE MAGNETIC FIELDS. S.K.Trehan.
Astrophys. J., Vol. 126, No. 2, 429-56 (Sept., 1957).

The stability of force-free magnetic fields is investigated to find whether the prevailing magnetic fields and the perturbations have cylindrical symmetry about an axis. A variational procedure is described for solving the characteristic value problem associated with the equations of motion. The characteristic frequencies are computed by using a one-parameter trial function. It is found that there are three modes of propagation for any disturbance. One of these modes is independent of gravity and is always stable. The second mode is only slightly dependent on gravity and is also stable. The third mode is markedly dependent on gravity. It is this mode which can be stable or unstable, depending on the values of the parameters involved. The criterion for instability is given.

538.3 : 532.5

8374. ON FORCE-FREE MAGNETIC FIELDS. J.Carstoiu.
C.R. Acad. Sci. (Paris), Vol. 248, No. 1, 73-5 (Jan. 5, 1959).
In French.

An analogue of Poynting's theorem is derived for fields for which $\vec{\nabla} \times \vec{H} = \alpha\vec{H}$. An expression derived for field intensities in the case $\alpha = \alpha(t)$ involves an exponential decay factor.

R.A.Newing

538.3 : 532.5

8375. ON FORCE-FREE MAGNETIC FIELDS.
A.M.Rozis-Saulgeot.
C.R. Acad. Sci. (Paris), Vol. 248, No. 18, 2555-7 (May 4, 1959).
In French.

It is shown that the hypothesis, due to Lüst and Schlüter, of force-free magnetic fields is not necessary in order to explain the equilibrium of an ionized fluid, for example, as found in interstellar H II regions. The equilibrant for the Lorentz force is supplied by the pressure gradient which is established as a result of the current in the presence of a magnetic field.

T.R.Carson

538.3 : 532.5

8376. THE STABILITY OF FORCE-FREE MAGNETIC FIELDS.
L.Woltjer.
Astrophys. J., Vol. 128, No. 2, 384-91 (Sept., 1958).

The stability of force-free magnetic fields is discussed. Force-free fields are stable against a spherically symmetric expansion. The axisymmetric fields, characterized by a constant ratio of magnetic-field strength and current, are stable against all axisymmetric disturbances, the normal component of which vanishes on the surface of the field-containing region. The bearing of the results on Jeans's criterion for gravitational instability is briefly discussed.

538.3 : 535.2

8377. ON THE REFLECTION AND REFRACTION OF HYDROMAGNETIC WAVES AT THE BOUNDARY OF TWO COMPRESSIBLE GASEOUS MEDIA. R.Simon.
Astrophys. J., Vol. 128, No. 2, 392-7 (Sept., 1958).

The reflection and refraction of a hydromagnetic plane wave at a plane boundary between two semi-infinite homogeneous media of infinite electrical conductivity are discussed when a uniform magnetic field is present. It is shown that, owing to the compressibility of the two media, one must expect any incident plane wave to give rise to three types of reflected wave and three types of refracted wave; these six waves can be either real of imaginary, depending on circumstances. In the particular case when the prevailing magnetic field is perpendicular to the plane boundary, a detailed analysis of the laws of reflection and refraction is given.

538.3 : 532.5

8378. MAGNETOHYDRODYNAMICS. S.I.Syrovatskii.
Fortschr. Phys., Vol. 6, No. 9, 437-503 (1958). In German.

A German version of the 1957 Russian review (Abstr. 5133 of 1958).

R.A.Newing

538.3 : 535

8379. RIEMANN WAVES IN MAGNETOHYDRODYNAMICS.
A.G.Kulikovskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 121, No. 6, 987-90 (1958). In Russian.

The magnetohydrodynamic equations describing isoentropic motion of a perfectly conducting ideal gas are considered for the special case where $\partial/\partial y = 0$, $\partial/\partial z = 0$, and $\partial/\partial t + (a + v_x)\partial/\partial x = 0$. The secular equation for a, the propagation velocity of the Riemann wave, is solved. One pair of solutions, $a = \pm H_x(4\pi\rho)^{-\frac{1}{2}}$, corresponds to Alfvén waves; the other two pairs correspond to two types of compression wave. In each case the solutions for the magnetohydrodynamic field variables are indicated. It is stated that the Alfvén waves do not change their form with time, but that the compression waves will develop into shocks. A method for dealing with the hydromagnetic shock conditions is given; it yields the pressure behind the shock as a function of the pressure in front of it, and the transverse and longitudinal magnetic field components behind and in front of it.

O.Penrose

538.3 : 532.5

8380. THE SOLVABILITY OF NON-STATIONARY PROBLEMS OF MAGNETOHYDRODYNAMICS.
O.A.Ladȳzhenskaya and V.A.Solonnikov.
Dokl. Akad. Nauk SSSR, Vol. 124, No. 1, 26-8 (1959). In Russian.

This note discusses mathematically the existence of solutions of the magnetohydrodynamic equations for a viscous, incompressible, electrically conducting fluid with given initial and boundary conditions. The case considered in greatest detail is one where a conducting fluid and a conducting solid are surrounded by an insulating solid, in which the charge density is zero, itself surrounded by a perfectly conducting surface. For this case, there is outlined a method of proof, using function-space methods, for demonstrating the existence of solutions of the equations provided the initial conditions satisfy certain weak conditions.

O.Penrose

538.3 : 532.5

8381. THEORY OF THE MAGNETIC BOUNDARY LAYER.
V.N.Zhigulev.
Dokl. Akad. Nauk SSSR, Vol. 124, No. 5, 1001-4 (1959). In Russian.

This paper treats the boundary layer in a viscous electrically conducting fluid flowing in the x-direction past a semi-infinite conducting plate lying in the xz ($x > o$) half plane. Steady electric currents flow in the plate either (1) in the y-direction, or (2) in the x-direction. It is shown that the magnetic fields produced by these currents are shielded from the main part of the fluid by a thin boundary layer. Partial differential equations for the physical variables in this boundary layer are formulated, using the approximation that the Reynolds number is large. For the case when the liquid is incompressible and the flow steady, similarity solutions of these equations are obtained, which reduce the problem to the solution of ordinary differential equations analogous to Blasius's equation.

O.Penrose

538.3 : 532.5

8382. THE PROBLEM OF A CONDUCTING SPHERE SITUATED IN A TRAVELLING MAGNETIC FIELD. Yu. K. Krumin'.
Latv. PSR Zinat. Akad. Vestis, 1957, No. 5 (118), 119-29. In Russia

The problem is considered of a sphere, conducting or semiconducting, situated in a gradually increasing magnetic field. The sphere is placed with its centre on the axis of a cylindrical field. The basic equations are derived and solved and the forces acting on the sphere calculated. The simpler case of a non-ferromagnetic metal is also given. In the experimental work, which shows satisfactory agreement with theory, a cardboard tube with 3-phase windings on it provided the field. Forces were measured by a balance arrangement on spheres of 5, 3.3, 2.5 and 1.7 cm diameter made of Cn, Al, Sn, Pb. Curves are given of force versus frequency and force versus sphere radius.

C.R.S.Manders

538.3 : 532.5

8383. CHARACTERISTIC MANIFOLDS IN THREE-DIMENSIONAL UNSTEADY MAGNETOHYDRODYNAMICS. R.S.Ong.

Phys. of Fluids, Vol. 2, No. 3, 247-51 (May-June, 1959).

The technique developed in the general theory of discontinuities is applied to the basic equations of unsteady magnetohydrodynamics in order to find the conditions to be satisfied by the discontinuities in the derivatives of the significant flow and magnetic field parameters. In the formulation of the basic equations use is made of the "magnetohydrodynamics approximation". This amounts to the assumption that the magnetic energy is very large compared with the electric energy, or physically, that the displacement current is negligible. The fluid itself is considered to be infinitely conductive, inviscid, and compressible. With the aid of the relations satisfied by the jumps in the derivatives of the parameters the various characteristic manifolds are found. Finally, it is shown that these manifolds are hypersurfaces along which small disturbances and weak shocks are propagated.

538.3 : 532.5

8384. SOLUTIONS OF THE EQUATIONS OF MAGNETIC GAS DYNAMICS FOR ZERO TEMPERATURE GRADIENT.

V.P.Korobeinikov and E.V.Ryazanov.

Dokl. Akad. Nauk SSSR, Vol. 124, No. 1, 51-2 (1959). In Russian.

Treats the one-dimensional motion of an ideal gas of infinite thermal and electrical conductivity. Particular solutions of the equations of motion, each containing an arbitrary function of one variable, are presented both for plane and cylindrical symmetry. A solution involving a shock wave is also obtained. O.Penrose

538.3 : 532.5

8385. ON INITIAL CONDITIONS IN HYDROMAGNETICS.

G.S.S.Ludford.

Proc. Cambridge Phil. Soc., Vol. 55, Pt 1, 141-3 (Jan., 1959).

The hydromagnetics of an inviscid thermally-insulating compressible fluid of electrical conductivity σ and dielectric constant ϵ are considered. It is shown that, for arbitrary initial conditions, if ϵ is finite and σ indefinitely large then E relaxes to the value $-v \times B$ in a time of order ϵ/σ. During this process B and the hydromagnetic variables will normally remain approximately constant. Moreover, it is stated that for fixed σ and indefinitely small ϵ, E relaxes to the value $(1/\sigma)$ curl $H - v \times B$ (that is, the displacement current becomes negligible) in a time of order ϵ/σ.

O.Penrose

538.3 : 532.5

8386. SOME EXACT SOLUTIONS OF THE NAVIER—STOKES AND THE HYDROMAGNETIC EQUATIONS. W.C.Meecham.

Phys. of Fluids, Vol. 2, No. 2, 121-4 (March-April, 1959).

Some exact, closed-form solutions of the Navier—Stokes equations for incompressible flow and of the hydromagnetic equations for high-conductivity, incompressible flow are presented. They can be considered to be generalizations of Taylor's solutions. The solutions are two dimensional and cellular containing a single-space Fourier component; the spatial behaviour is chosen in such a way that the nonlinear inertial term and the pressure term cancel one another, leaving a linear system to be solved. The time behaviour of the solutions is quite general. The solutions to the hydromagnetic equations are such that the velocity and the magnetic fields are parallel and decoupled. The velocity behaves as it does in the purely mechanical case while the magnetic field simply decays in time; there is no source term for it in the present treatment.

538.3 : 532.5

8387. INHIBITION OF HYDRODYNAMIC INSTABILITY BY AN ELECTRIC CURRENT. C-S.Yih.

Phys. of Fluids, Vol. 2, No. 2, 125-30 (March-April, 1959).

The inhibition of instability of a viscous fluid contained in a circular cylinder and heated from below by an electric current was investigated. Previous results indicate that, for a thermally non-conducting wall, the critical Rayleigh number is 452.1 for symmetric convection, and 67.9 for the first (and critical) mode of unsymmetric convection. It was found in this investigation that unsymmetric convections can be delayed or completely inhibited by an electric current, whereas symmetric convection is not at all affected. This indicates a very interesting physical situation at Rayleigh number 452.1, for an electric current just strong enough to inhibit unsymmetric convection. If the current is slightly increased, only symmetric motion will occur. If it is slightly decreased, unsymmetric convection, being more unstable, will prevail. Thus the physically significant solution of a differential system may have a sudden change of behaviour at certain critical values of its parameters.

538.3 : 532.5

8388. EFFECTS OF GRAVITATIONAL OR ELECTROMAGNETIC FIELDS ON FLUID MOTION. Chia-Shun Yih.

Quart. appl. Math., Vol. 16, No. 4, 409-15 (Jan., 1959).

Proudman (Abstr. 977/1916) showed that if the velocity of an incompressible inviscid fluid relative to a rotating reference frame is slow and steady, then this velocity must be independent of distance along the axis of rotation. Here similar results are obtained for the cases when instead of rotation there is either a uniform gravitational field, a uniform magnetic field, or the magnetic field of a uniform current. In each case the velocity, if steady and small, must be independent of distance along the lines of force. In the magnetic cases the fluid is assumed perfectly conducting.

O.Penrose

538.3

8389. APPLICATION OF INTEGRAL EQUATIONS TO THE SOLUTION OF THE MAXWELL EQUATIONS. J.Veit.

Slaboproudy Obzor, Vol. 19, No. 12, 866-7 (1958). In Czech.

It is assumed that the time dependence of the Maxwell equations is sinusoidal and that the electric field can be represented as $E = E_0 + E'$, while the magnetic field is $H = H_0 + H'$. E_0 and H_0 represent the fields in homogeneous media, while E' and H' take into account the effect of inhomogeneities. It is shown that E' and H' can be represented by triple integrals. The solutions for E and H can be found in terms of a series of successive approximations. A general expression for the n-th term of the series is derived (as a triple integral) and the conditions of the series convergence are determined. R.S.Sidorowicz

538.3 : 535.1

8390. UNIQUENESS CRITERION FOR THE SOLUTIONS OF MAXWELL'S EQUATIONS. P.Poincelot.

C.R. Acad. Sci. (Paris), Vol. 248, No. 15, 2182-4 (April 13, 1959). In French.

The uniqueness of sinusoidal solutions is established for linear media (without hysteresis effects) whose conductivity, dielectric and magnetic susceptibilities are continuous, except on isolated boundaries. J.K.Skwirzynski

538.3 : 530.12

PRINCIPLES OF ELECTROMAGNETIC THEORY AND RELATIVITY. See Abstr. 7765

538.3 : 530.12

ELECTROMAGNETIC INDUCTION IN GENERAL RELATIVITY. See Abstr. 7767

538.3 : 517.56

TOROIDAL FUNCTIONS. GENERAL SOLUTIONS OF LAPLACE'S EQUATIONS. See Abstr. 7721

538.3 : 532.5

8391. THE ENERGY THEOREM IN MAGNETOHYDRODYNAMICS FOR VISCOUS COMPRESSIBLE FLUIDS. G.Carini.

R.C. Accad. Naz. Lincei, Vol. 25, No. 6, 470-3 (Dec., 1958). In Italian.

The expression derived for the rate of change of energy includes both ohmic and viscous dissipation terms. It is verified that these terms vanish for a perfectly conducting medium in a state of rigid-body motion. It is also noted that the effective pressure in the fluid is $p - (\mu/8\pi)H^2$. R.A.Newing

ELECTROMAGNETIC WAVES AND OSCILLATIONS

538.561

8392. RADIATION OF AN ELECTRON IN AN INFINITELY LONG WAVEGUIDE. H.Motz and M.Nakamura.

Ann. Phys. (New York), Vol. 7, No. 1, 84-131 (May, 1959).

Deals with the electromagnetic fields excited by a single electron with prescribed motion in an infinitely long cylindrical space surrounded by perfectly conducting walls, and filled with a uniform linear medium. The medium is assumed to be lossy in order to avoid complexities arising from the radiation condition. The problem is attacked by first obtaining a general expression for the electric Hertz vector. From this Hertz vector the electric fields are calculated for (1) uniform motion of the electron parallel to the axis of a waveguide of arbitrary cross-section; (2) uniform but longitudinally oscillatory motion, and (3) undulating motion with constant velocity parallel to the axis of a rectangular waveguide. It is found that the electric field can be represented as the sum of residues corresponding to different field patterns. The power flow from the electron to the electromagnetic field is calculated. Cherenkov and undulator radiation are not the only causes of energy loss. In the presence of a dielectric medium power also flows into "electrostatic oscillations". Expressions for the energy loss of an electron similar to those previously given by Bohm and Pines and by Fermi are obtained by the present method. It is shown that an upper limit exists for the energy loss including Cherenkov and "electrostatic" loss. No such upper limit can be given in the case of undulator radiation. This is shown to be connected with the fact that the latter radiation is propagated both forward and backward. In the limit of infintely large cross-section of the waveguide the formulae tend to the results for the unbounded medium. This shows that the influence of the walls is correctly calculated.

538.561

8393. FLUCTUATIONS IN AMPLIFICATION OF QUANTA WITH APPLICATION TO MASER AMPLIFIERS.
K.Shimoda, H.Takahasi and C.H.Townes.
J. Phys. Soc. Japan, Vol. 12, No. 686-700 (June, 1957).

Fluctuations in the amplification and absorption of waves by quantum processes are considered. Assuming for each quantum the probability (per unit time) a of producing another quantum, probability b of being absorbed, and assuming a probability c that a new quantum is introduced, a set of differential equations is obtained. By solving these equations, a complete expression for the probability of distribution of quanta is obtained, as well as expressions for the average values and fractional fluctuation. The expressions developed are applied in particular to maser-type amplifiers, and certain fluctuations in the amplification of electromagnetic waves are pointed out which are important when their quantum character becomes significant. This condition can occur in maser-type amplifiers, where thermal and extraneous noises may be very small. For such an amplifier, a is proportional to the number of excited molecules, whereas b consists of a term proportional to the number of molecules in the ground state plus terms due to certain other losses. The noise temperature of a maser-type travelling-wave amplifier is the "effective temperature" $a(a-b)^{-1}h\nu/k$. In super-regenerative and regenerative amplifiers using resonant cavities, the noise temperature is rather similar, if losses through the input coupling hole are excluded from b. In any case, the limiting noise for an ideal amplifier corresponds to a classical noise temperature of $h\nu/k$.

538.566 : 535.13

8394. ON THE PROPAGATION OF MUTUAL COHERENCE.
G.B.Parrent, Jr.
J. Opt. Soc. Amer., Vol. 49, No. 8, 787-93 (Aug., 1959).

Section 1 presents a brief history of the development of coherence theory and discusses some of the advantages of Wolf's general formulation of the theory in terms of Gabor's analytic signals. Section 2 contains an analysis of the limiting cases of coherence and incoherence, showing for these extremes the form of the mutual coherence function in a quasi-monochromatic field. In particular it is shown that in such a field coherence is characterized by a mutual coherence function which, apart from a simple periodic factor, is expressible as the product of a wave function with its complex conjugate, each factor depending on the coordinates of one point only. It is also shown that an incoherent field cannot exist in free space. The mutual coherence function obeys rigorously two wave equations, and in Section 3 these equations are solved with the help of appropriate Green's functions to find the field produced by a general plane polychromatic source. The solution is simplified by the quasi-monochromatic approximation; and the limiting cases are discussed in detail showing that a coherent source always gives rise to a coherent field, and that a theorem of Van Cittert and Zernike represents an approximation to the incoherent limit of the quasi-monochromatic solution.

538.566.3 : 551.594.2 : 621.396.821

"WHISTLER MODE" ECHOES REMOTE FROM THE CONJUGATE POINT. See Abstr. 7697

538.567 : 537.311.33

FARADAY EFFECT IN SEMICONDUCTORS. See Abstr. 8098

NUCLEAR AND ATOMIC PHYSICS

539.1 : 541

8395. RELATION x + y = 136 BETWEEN THE NUCLEAR AND CHEMICAL STABILITY NUMBERS. D.E.Lynch.
Amer. J. Phys., Vol. 26, No. 3, 198-9 (March, 1958).

APPARATUS . PARTICLE DETECTORS

539.1.07

8396. FATIGUE EFFECTS ON THE CATHODE OF SELF-QUENCHING GM COUNTERS. O.Orient.
Acta phys. Hungar., Vol. 9, No. 3, 343-5 (1959).

Describes measurements made with Cu and Ni cathode self-quenched counters filled with ethyl-bromide/argon mixtures. Plateau slopes and plateau lengths were measured for various total counts. Separate measurements of cathode work function were made also as a function of total counts. The data are shown graphically and briefly discussed. J.D.Craggs

539.1.07

8397. ON THE TEMPERATURE EFFECT OF SELF-QUENCHING GEIGER-MÜLLER COUNTERS. A.Peeva and T.Karatoteva.
C.R.Acad. Bulg. Sci., Vol. 11, No. 5, 359-62 (Sept.-Oct., 1958).

Describes an experimental investigation of the dependence of the temperature effect in organic vapour-quenched counters, on the adsorption at the anode and the cathode, respectively. The results show a strong dependence of the effect on the adsorption at the anode. J.M.Zarzyck

539.1.07 : 537.533

8398. ON THE RESPONSE OF OPEN GEIGER COUNTERS TO SURFACE DISCHARGES ON DEFORMED ORGANIC INSULATORS.
B.Sujak.
Czech. J. Phys., Vol. 7, No. 5, 627-8 (1957). In German.

A very brief note outlining experiments on cold emission of electrons using open point counters in which, virtually, the primary emission occurs. J.D.Craggs

539.1.07 : 537.525

8399. A DEVIATION FROM WILKINSON'S THEORY OF DISCHARGE SPREAD IN GEIGER-COUNTERS. S.Puri.
Indian J. Phys., Vol. 31, No. 9, 441-6 (Sept., 1957).

Measurements of the velocity of propagation of discharge in Geiger counters were made by the method of delayed coincidences. The measurements are interesting only in showing a divergence of results from the theory after the point where the charge generated becomes equal to the charge on the central wire. The spread due to electrons is considered to take a lead over the spread by virtue of ultraviolet photon content of the earlier avalanches after this point.

539.1.07

8400. PHOTOIONIZATION VERSUS PHOTOELECTRIC EFFECT FOR DISCHARGE SPREAD AND OUTPUT PULSE MEASUREMENTS IN G-M COUNTERS. P.S.Gill and S.P.Puri.
Indian J. Phys., Vol. 31, No. 11, 564-71 (Nov., 1957).

The probability of discharge spread v. overvoltage was measured in a multicathode, single-anode counter, by keeping dead the space across which the discharge spreads. The pulse size v. voltag curves for the externally coated counters, reveal that the operation of the soft glass type is analogous to that of the conventiona counter, whereas in the case of the Pyrex counter, the deposition of the positive ions across the inner glass surface develops an opposing e.m.f., which varies linearly with the overvo age. In addition, discharge spread probability was studied as a function of overvoltage in a multicathode, segmented counter, making us of beads sealed on to the wire. The beads suppress the photoionization contribution by reducing the field around them, thus eliminatin altogether the photoionization near the immediate vicinity of the wire, which, in normal operation, contributes to the stepwise discharge spread. The photoelectric effect responsible for discharge spread remains negligibly feeble but constant over an overvoltage of about 400 V in the case of the present counter with the rare gas-organic vapour admixture.

539.1.07 : 537.525

SIMILARITY THEOREM FOR AIR UNDER LOW FREQUENCY DISCHARGE USING A MAZE COUNTER. See Abstr. 8188

539.1.07

8401. THE GASDISCHARGE MECHANISM FOR THE ARGON—ALCOHOL PROPORTIONAL COUNTER. K.van Duuren and G.J.Sizoo.
Appl. sci. Res. B, Vol. 7, No. 5, 379-99 (1959).

Accurate measurements of the gas multiplication factor A were done for a number of proportional counters with various wire diameters ranging from 0.003 to 0.1 cm and for various gas pressures ranging from 67 to 220 mm Hg. From these results the ionization coefficient for the argon—alcohol gas mixture 9 : 1 could be deduced. It appeared that in a few cases the equilibrium between the mean electron energy and the electrical field was slightly disturbed and the conditions for the non-equilibrium situation could be established from the experiments. Rose's and Korff's calculations of the gas multiplication factor in proportional counters were compared with the present experimental results, whereby rather large discrepancies were found. Comparison of the present experimental values of the ionization coefficient for argon—alcohol with the earlier published values for pure argon and alcohol gives an insight in the mechanism of the electron multiplication process in the argon—alcohol gas mixture 9 : 1.

539.1.07

8402. ON THE DEPENDENCE OF THE GAS-AMPLIFICATION FACTOR WITH PROPORTIONAL COUNTER VOLTAGE.
L.G.Khristov.
C.R. Acad. Bulg. Sci., Vol. 10, No. 6, 453-6 (Nov.-Dec., 1957).

Gives a simple theoretical treatment of amplification factors in terms of gas constants, counter geometry and the counter tube voltage. The formula so derived was previously, in empirical form, shown to agree in general with practice. J.D.Craggs

539.1.07

8403. INVESTIGATION INTO SLOW NEUTRON COUNTERS.
V.Ya.Savel'ev and V.A.Kononenko.
Pribory i Tekh. Eksper., 1959, No. 1, 61-4 (Jan.-Feb.). In Russian.

Gives a simplified theory of slow neutron BF_3-filled counter, deriving equations for the dependence of the height of the pulse, efficiency and "starting" voltage on the pressure of BF_3 gas and the constructional parameters of a counter. Also, results of experimental investigation are given, showing very good agreement with the theory. J.M.Zarzycki

539.1.07

8404. PLATEAU SLOPES AND PULSE CHARACTERISTICS OF LARGE, HIGH-PRESSURE BF_3 COUNTERS.
R.B.Mendell and S.A.Korff.
Rev. sci. Instrum., Vol. 30, No. 6, 442-4 (June, 1959).

Factors affecting the flatness of plateaus of BF_3 neutron counters of large radius and at high pressure were investigated. Counters prepared using special purification techniques showed improved characteristics. Counters of cathode radius from 1.91 to 5.06 cm were filled to pressures of BF_3 from 40 to 64 cm Hg, and their pulse-height distributions were compared. Results are discussed in terms of electron attachment in BF_3 and space charge effects.

539.1.07

8405. IONIZATION CHAMBER FOR THE INVESTIGATION OF COSMIC RAYS. N.N.Goryunov and A.D.Erlȳkin.
Pribory i Tekh Eksper., 1959, No. 1, 130-1 (Jan.-Feb.). In Russian.

A chamber is described which uses electron collection and in which the working volume is in the form of a cube with each side 25 cm. This permits the compact packing of counters recording cosmic rays over an area. The collecting electrode is a vertical cylinder 1 cm diameter, 10 cm long, and the chamber is filled to 850 mm pressure with 98% A—2% N_2. The operating voltage was 900V and the effective volume, found by placing alpha emitters in various places in the counter, was 95% of the geometrical volume. The field distribution in the cube was found to 10% with the help of a resistance network analogue. Empirical formulae are given for the variation of collector charge with time after uniform ionization of the chamber; most is collected within 50 μ sec. J.H.Fremlin

539.1.07

8406. THE RESPONSE POWER OF PARALLEL-PLATE SPARK-COUNTERS FOR WEAKLY IONIZING PARTICLES.
E.Bagge and U.C.Allkofer.
Atomkernenergie, Vol. 2, No. 1, 7-17 (Jan., 1957). In German.

Experimental determinations were made of the dependence of the response power R on over-voltage for various mixtures of A with alcohol, ether and acetone; the best operating conditions were found to be at high over-voltages with a mixture of A and acetone. Calculations of R, based on values of the primary ionization coefficient obtained by a pulse method, for the various mixtures were in good agreement with experiment. J.Dutton

539.1.07

8407. WIRE-ROD SPARK COUNTERS IN AIR.
L.Daddi and L.De Franceschi.
Rev. sci. Instrum., Vol. 30, No. 6, 419-24 (June, 1959).

The operating characteristics of the Rosenblum type spark counters in air are examined. A qualitative interpretation of the experimental data is given. The advantages of the device (no background, absence of walls, detection of heavily ionizing particles only) and its disadvantages (limited reproducibility for some incidence directions, small sensitive volume), which limit its practical utilization, are reported.

539.1.07

8408. SCINTILLATION COUNTER EFFICIENCY MEASUREMENT.
S.A.Colgate.
Rev. sci. Instrum., Vol. 30, No. 2, 140-1 (Feb., 1959).

A note drawing attention to a simple method of determining the number of photo-electrons/MeV of absorbed energy in a scintillation counter. The pulse-height due to single photo-electrons, ejected by a weak light flux falling on the photo-multiplier cathode, is obtained as the change in discriminator setting corresponding to 1/e change in counting rate. This is compared directly with the pulse-height observed with a source of ionizing radiation of known energy, e.g. Cs^{137} γ-rays. The author has consistently observed 1000 photo-electrons/MeV with NaI(Tl) crystals with perfect optical coupling. J.B.Birks

539.1.07

8409. FILAMENT SCINTILLATION COUNTER.
G.T.Reynolds and P.E.Condon.
Rev. sci. Instrum., Vol. 28, No. 12, 1098-9 (Dec., 1957).

Filaments of plastic scintillator, of 0.5-1.0 mm diameter and several feet long, have been prepared and used in a scintillation counter. A filament scintillator, prepared by stacking short lengths of rods in a Lucite tube, was compared with a solid plastic scintillator of similar sensitive volume. The peak pulse heights observed with the filament and solid scintillators for the Cs^{137} internal conversion electrons were 0.54 : 1, indicating that a minimum ionizing particle passing through a 1 mm diameter filament yields 110 photons at the end of the filament. Viewed with image intensifier tubes, these filaments should provide a solid scintillation chamber capable of fast timing and good space resolution. J.B.Birks

539.1.07 : 537.533

8410. IMPROVED PERFORMANCE OF PHOTOMULTIPLIERS IN SCINTILLATION COUNTERS.
A.Ashmore, B.Collinge and S.K.Sen.
Indian J. Phys., Vol. 31, No. 5, 261-4 (May, 1957).

The use of a cathode follower to reduce the effective capacity to earth of the collecting electrode of a photomultiplier, enables bigger voltage pulses to be obtained for the same degree of non-linearity in the photomultiplier. The investigation has been made of the improvement obtained with an E.M.I. 6260 photomultiplier under typical operating conditions.

539.1.07

8411. SPIRAL CAPILLARY PLASTIC SCINTILLATION FLOW COUNTER FOR BETA ASSAY. B.L.Funt and A.Hetherington.
Science, Vol. 129, 1429-30 (May 22, 1959).

Tracer counting of beta emitters in aqueous solution was performed with a detector fabricated from a plastic scintillator capillary. The detector exhibits low gamma background and reproducible detection efficiency, and it requires minimum sample preparation. Counting efficiencies were determined for aqueous solutions of P^{32}, Na^{22}, and C^{14} and for $C^{14}O_2$ gas.

539.1.07

8412. MASS SENSITIVE DETECTOR FOR RELATIVISTIC ELECTRONS. L.Marshall.
Rev. sci. Instrum., Vol. 30, No. 6, 412-14 (June, 1959).

A detector is proposed whose mass sensitivity increases with increasing particle energy. The counter detects synchrotron radiation emitted by relativistic particles as they travel through a high-intensity magnetic field. The power emitted in synchrotron radiation varies inversely as the rest mass to the fourth power, and the frequency of the spectral region in which the main power is emitted varies inversely as the rest mass cubed. In 50 cm path of a presently practicable magnetic field, 10^5 G, an electron of 1 BeV emits on the average 10 photons with a total energy of 68 keV, each of about 7 keV. This radiation when converted to visible radiation in NaI crystals is detectable by photomultipliers. In application to cosmic rays, with a steady-state magnetic field, the counter enables specific recognition of electrons of ≥ 1 BeV.

539.1.07

8413. A DETECTOR FOR SLOW NEUTRONS. M.Voříšek.
Czech. J. Phys., Vol. 7, No. 6, 757-66 (1957). In German.

An experimental investigation of the characteristics of scintillation detectors made of melted mixtures of ZnS:Ag and B_2O_3 shows that the optimum ratio of ZnS to B is about 8 : 1 and the optimum thickness about 0.75 mm. With low γ-ray backgrounds an efficiency for thermal neutrons of about 25% can be obtained; the detector can also be used with high γ-ray backgrounds by suitable adjustment of the discriminators. J.Dutton

539.1.07 : 539.12

8414. SCINTILLATION COUNTER METHOD OF INTERCOMPARING NEUTRON SOURCE STRENGTHS BY MEANS OF A MANGANOUS SULFATE BATH. E.R.Mosburg, Jr.
J. Res. Nat. Bur. Stand. Vol. 62, No. 5, 189-91 (May, 1959).

It has proved feasible to use a scintillation counter to measure the relative activity of a large manganous sulphate bath, thereby determining the neutron-emission rates of neutron sources relative to the national standard neutron source of the National Bureau of Standards. A scintillation counter allows the calibration of sources weaker by a factor of seven than those it was previously possible to calibrate by means of a Geiger-Muller counter. The use of Cs^{137} as a reference pulse height to which the scintillation counter system is adjusted by means of a two channel pulse height analyser makes possible the reliable reproduction of results from day to day. By using the scintillation counter the ratio of the national reference standard neutron source (NBS-II) to the national standard neutron source (NBS-I) has been redetermined and is found to be $0.939_3 \pm 0.001_7$.

539.1.07

8415. A CHERENKOV GAS COUNTER OF HIGH EFFICIENCY. M.Beneventano, E.De Agostino, C.A.Galtieri, B.Rispoli and A.Serra.
Nuovo Cimento, Vol. 12, No. 2, 156-63 (April 16, 1959). In Italian.

The performance of a CO_2 counter has been studied. The efficiency of the counter for cosmic-ray μ-mesons with momentum greater than 1.75 GeV/c has been measured as a function of gas pressure. Preliminary results give for the efficiency the value (96.7 ± 1.1)% at the pressure of 10.23 atm N.P.T.

539.1.07

8416. A NEW TYPE OF IONIZATION RADIATION MONITOR. J.Oppelt.
Czech. J. Phys., Vol. 7, No. 1, 102-5 (1957).

A simple electronic circuit used with an ionization chamber as a $\gamma - \beta$ radiation monitor is described. The instrument measures dosage and dose-rate simultaneously. J.B.Birks

539.1.07

8417. DETERMINATION OF THE PLACE OF ORIGIN OF CHARGED PARTICLES WITH THE AID OF SPARK-COUNTERS. P.G.Henning.
Atomkernenergie, Vol. 2, No. 3, 81-8 (March, 1957). In German.

The presence of an ionizing particle can be detected as a fine canal-discharge in a spark counter filled with a suitable gas mixture. By arranging a number of these counters in coincidence the track of the particle may be determined photographically. In order to distinguish between coincident and single discharges an extra capacitance is automatically shunted across the counters during coincidence, leading to a brighter discharge.
A.E.I. Research Laboratory

539.1.07 : 537.525

8418. AUTOMATIC CLOUD CHAMBER FOR GAS DISCHARGE STUDIES. K.R.Allen and K.Phillips.
Rev. sci. Instrum., Vol. 30, No. 4, 230-4 (April, 1959).

A large volume expansion chamber (25 cm diameter, 25 cm deep) was constructed to investigate prebreakdown ionization processes in gaseous discharge. A homogeneous field electrode system was mounted within the chamber and provision was made for irradiation of the cathode. The chamber could be operated automatically at pressures from 40 to 68 cm Hg with a recycling time of about 5 min. Associated circuits for the production of millimicrosecond pulses up to 70 kV (peak) are described. Some preliminary photographs of point-plane breakdown and of electron avalanches in a homogeneous field electrode system are shown.

539.1.07

8419. BUBBLE CHAMBERS. E.V.Kuznecov.
Fortschr. Phys., Vol. 7, No. 1, 48-77 (1959). In German.

Complete translation into German of paper abstracted in Abstr. 4202 of 1958.

539.1.07

8420. USE OF CARBONIC ACID AS A WORKING LIQUID IN A BUBBLE CHAMBER. E.V.Kuznetsov and I.Ya.Timoshin.
Pribory i Tekh. Eksper., 1959, No. 1, 132 (Jan.-Feb.). In Russian.

Describes a bubble chamber of 2.5 litre capacity, filled with carbonic acid at the saturated vapour pressure of 37.5-48.5 atm (at 3.5-13.5°C). The windows were made of Plexiglas and rubber was used for the gaskets and the membrane. If the chamber is to be emptied fairly frequently, it is perferable to use glass for the windows and polythene or polytetrafluorethylene for the gaskets and the membrane, since Plexiglas and rubber absorb carbonic acid.
A.Tybulewicz

539.1.07

8421. PERFORMANCE OF A PISTON-EXPANDED BUBBLE CHAMBER.
H.Courant, J.E.Jensen, R.I.Louttit and J.R.Sanford.
Rev. sci. Instrum., Vol. 30, No. 4, 280-1 (April, 1959).

With liquid hydrogen as the track sensitive medium, electron tracks were observed from 26.1° to 28.9°K. Using liquid deuterium, the range was 30.5° to 32.6°K. The upper limits in both cases were imposed by the apparatus. Data on expansion pressures, sensitive times, and refrigerant consumption are presented.

539.1.07

8422. NUCLEAR EMULSIONS WITH POWDER FILLERS. S.S.Vasil'ev, V.V.Komarov and A.M.Popova.
Pribory i Tekh. Eksper., 1959, No. 1, 48-50 (Jan.-Feb.). In Russian.

A method of preparation of nuclear emulsions with fillers in the form of fine-powder layers, placed between emulsion layers, is described. Such emulsions are then used to study nuclear reactions at medium energies on the filler substances (Be, B, C, etc.).
A.Tybulewicz

539.1.07 : 771.531

8423. CONCERNING AMIDOL DEVELOPMENT OF NUCLEAR EMULSIONS. G.D.Fatzer.
Rev. sci. Instrum., Vol. 30, No. 1, 22-7 (Jan., 1959).

A lowering of the development temperature introduces development defects which are characterized by the partial or total destruction of the developed image and by a deep coloration of the emulsion. These defects are eliminated by increasing the sodium sulphite concentration of the developer. Up to now contrast in nuclear emulsions has been evaluated subjectively by the experimenter; this forbids any comparison of the results obtained in different laboratories. This paper shows that to develop reliably at low temperatures with the usual developers, it becomes necessary to increase the ratio $(Na_2SO_3)/(\text{Amidol})$. For development temperatures of 10-15°C the concentration ratio needs to be 70% greater th the ones commonly used. A study of track and fog grain properties is carried out. It is shown that at a given temperature the mean gap length is practically independent of the development parameters The optimum conditions at 14°C are determined with the help of a new quantity termed "track visibility" (K), a track to fog signal, and defined by K = blob length × track grain diameter/fog density × × (fog grain diameter).

539.1.07 : 621.374.3 : 621.317.7

8424. A NEW TYPE OF PULSE-HEIGHT ANALYSER FOR RAPID PULSES. C.Rubbia and G.Torelli.
Nuovo Cimento, Vol. 12, No. 2, 144-7 (April 16, 1959). In Italian.

A new type of pulse-height analyser using a beam deflection tube is described. The use of these tubes allows such a circuit to work at high repetition rate, without structural complexities.

539.1.07 : 537.591 : 621.396.946

8425. COSMIC-RAY INSTRUMENTATION IN THE FIRST U.S. EARTH SATELLITE. G.H.Ludwig.
Rev. sci. Instrum., Vol. 30, No. 4, 223-9 (April, 1959).

Explorer I (1958 α) carried instrumentation to measure cosmic-ray intensity, micrometeorite impacts, and temperatures within the satellite. The instrumentation was designed with emphasis on conservation of electrical power, on stable and reliable operation, on operation over a wide range of temperatures, and on compactness and mechanical ruggedness. The cosmic-ray instrumentation operated according to expectations, providing several hundred recordings of data received during transits over ground stations. These data led to the discovery of a belt of high-intensity radiation around the earth.

539.1.07 : 621.374.32

8426. TEN-Mc PULSE-AMPLITUDE DISCRIMINATOR. J.Mey.
Rev. sci. Instrum., Vol. 30, No. 4, 282-4 (April, 1959).

A pulse-height discriminator has been developed which is capable of operating at repetition rates up to 10 Mc/s. It accepts positive input pulses with a threshold adjustable from 1 to 11 V. The output signal is of constant shape and amplitude. The circuit is described and test results are given.

539.1.07 : 550.9

8427. REDUNDANT CIRCUITRY FOR RELIABILITY IN LOW-LEVEL COUNTING. W.H.Burke, Jr.
Rev. sci. Instrum., Vol. 30, No. 5, 333-5 (May, 1959).

A system of redundant counting circuitry is described which has been used for about two years in carbon-14 dating. The use of this circuitry enables the operator to know when a measured counting rate is unreliable because of electronic trouble, either steady or intermittent. It also enables him to continue taking reliable data despite most intermittent troubles, and aids in locating them.

539.1.07

8428. SEMIAUTOMATIC TOWNSEND BALANCE SYSTEM. S.B.Garfinkel.
Rev. sci. Instrum., Vol. 30, No. 6, 439-42 (June, 1959).

A semiautomatic system has been developed for use with a Lindemann—Ryerson electrometer. The system measures ionization current in the N.B.S. 4π γ-ionization chamber by Townsend balance-of-charge method. Two miniature semiconductor photocells, with associated electronic circuitry, are used for detecting deflections of the electrometer and for controlling the amount of compensating charge placed on the electrometer. In addition, the starting and stopping of an electronic clock is controlled by a third photocell. The system has an ultimate precision of about 0.02%.

539.1.07 : 621.374.32

8429. TRANSISTOR CIRCUITRY FOR RADIATION COUNTING. J.R.Gilland.
Rev. sci. Instrum., Vol. 30, No. 6, 479-84 (June, 1959).

The circuits described are a pulse amplifier, a pulse-height analyser, a scaler, and a linear count-rate meter. The basic operating principles are discussed briefly. The electrical characteristics of these instruments compare favourably with their vacuum-tube counterparts and they have the additional advantages of improved reliability, small size, and low power consumption.

539.1.07

8430. SECOND-ORDER CONTAMINATION IN A NEUTRON CRYSTAL SPECTROMETER. R.Haas and F.J.Shore.
Rev. sci. Instrum., Vol. 30, No. 1, 17-21 (Jan., 1959).

The second-order contamination in the Brookhaven neutron crystal spectrometer is measured for the NaCl(220), NaCl(240), Be$(10\bar{1}1)$, and Be$(12\bar{3}1)$ reflections over the energy range from 0.08 to 5 eV. Reflectivity calculations by Holm (1953) for neutrons incident on thin crystals of Be and NaCl are verified experimentally. A method is suggested for rapidly calculating the second-order fraction of the beam using a simple count rate spectrum and the calculated crystal reflectivities.

539.1.07 : 539.165

8431. USE OF β SPECTROMETERS WITH LINEARLY INCREASING MAGNETIC FIELD. G.A.Groma and E.F.Pócza.
Rev. sci. Instrum., Vol. 29, No. 5, 442-3 (May, 1958).

Electron paths are plotted for various angles of entrance in the field, the equations of motion having being solved by numerical integration. A suitable coordinate transformation indicates that if a ring target is located near the trajectory maximum, the arrangement may be used as an analyser. Focusing is possible for angles of entrance not exceeding 45°. This type of field is realized by an air-core solenoid designed by graphical successive approximations.

I.C.Demetsopoullos

539.1.07

8432. RING DETECTION IN A THIN-LENS MAGNETIC SPECTROMETER. K.C.Mann and F.A.Payne.
Rev. sci. Instrum., Vol. 30, No. 6, 408-12 (June, 1959).

Ring detection has been carried out in a thin-lens beta-ray spectrometer by locating anthracene crystals at the ring focus of the electron trajectories. The geometry of the electron focusing has been investigated for gathering powers of 1.6, 1.1, and 0.7% at mean emission angle tangents of 0.400, 0.385, and 0.352 and the resolutions obtained have been tabulated. At a gathering power of 1.6% a line width of better than 1.37% in momentum has been achieved. A comparison of this instrument with other helical spectrometers is made.

539.1.07

8433. A HIGH-SPEED COMPTON TWO-CRYSTAL GAMMA-SPECTROMETER. V.V.Ovechkin and A.A.Sorokin.
Pribory i Tekh. Eksper., 1959, No. 1, 36-40 (Jan.-Feb.). In Russian.

Describes a two-crystal gamma-spectrometer without collimation of the gamma-beam. The spectrometer records Compton recoil electrons. A technique for eliminating the effect of cascade transitions is described. The speed of the spectrometer (the ratio a^2/f^2, where a is the aperture and f is the focal length) in the energy range 511-2100 keV was found to be 400 times higher than the speed of the Compton spectrometer with collimation described by Stolyarova and Konstantinov (see preceding abstract).

A.Tybulewicz

539.1.07 : 539.166

8434. A TWO-CRYSTAL SCINTILLATION GAMMA-SPECTROMETER. E.L.Stolyarova and I.E.Konstantinov.
Pribory i Tekh. Eksper., 1957, No. 1, 28-31 (Jan.-Feb.). In Russian.

Describes a scintillation gamma-spectrometer, with two NaI:Tl crystals and a coincidence circuit, which records Compton recoil electrons. The spectra of Hg^{203}, Cs^{137} and Co^{60} were obtained by means of this spectrometer and are listed. (See also following abstract). A.Tybulewicz

539.1.07

8435. SCINTILLATION SPECTROMETER WITH AN ANTI-COINCIDENCE ANNULUS OF NaI(Tl). C.C.Trail and S.Raboy.
Rev. sci. Instrum., Vol. 30, No. 6, 425-9 (June, 1959).

In the scintillation spectrometer described, the main detecting crystal of NaI(Tl) is enveloped by a hollow cylinder of NaI(Tl) in anticoincidence with the main crystal. This system completely suppresses the peaks associated with the escape of the two quanta from the annihilation following pair production, and it reduces the Compton background by a factor of 7 for 4.43 MeV gamma rays and by a factor of 5 for those of 6.1 MeV.

539.1.07

8436. SYNTHETIC MICA AS A MONOCHROMATOR FOR LONG WAVELENGTH NEUTRONS.
A.N.Goland, J.H.Sondericker, Jr and J.J.Antal.
Rev. sci. Instrum., Vol. 30, No. 4, 269-71 (April, 1959).

A comparison has been made between natural muscovite mica and synthetic fluor-phlogopite mica with regard to their usefulness as neutron monochromators. It has been found that a synthetic mica monochromator reflects a neutron beam which is from 2 to 6 times more intense than that from a natural mica monochromator, while requiring no appreciable sacrifice in resolution. The interplanar spacing of the synthetic material was found to be 9.963 A, which is slightly larger than that of the natural mineral.

539.1.07 : 539.23

PREPARATION OF VERY THIN FOILS. See Abstr. 7539

ELEMENTARY PARTICLES

539.12 : 530.145

PARITY NON-CONSERVATION AND THE ALGEBRA OF ELEMENTARY PARTICLES. See Abstr. 7775

539.12

8437. CONNECTION BETWEEN MASSES AND ISOBARIC SPIN.
E.Minardi.
Nuclear Phys., Vol. 12, No. 1, 35-57 (June (3), 1959).

A fundamental theory of the elementary particles is presented assuming a dependence of the function describing a particle on two space–time variables and symmetry of the fundamental equations between them. All masses, with the exception of charged pions and muons, but including the electron mass of purely electromagnetic origin, are predicted with a remarkable accuracy introducing a universal length as the only adjustable parameter. The strangeness and the Gell-Mann–Nishijima scheme find a simple interpretation; the isobaric spins of the different masses arise as an automatic consequence of the formalism. It is shown that the theory implies an indefinite metric. The existence of a pion with zero isobaric spin is predicted by the theory. In the appendix an attempt is presented to explain the existence of the pions with isobaric spin $T = 1$ and of the muons.

539.12

8438. ON THE MASSES OF ELEMENTARY PARTICLES.
A.Salam and J.Tiomno.
Nuclear Phys., Vol. 9, No. 4, 585-7 (Jan. (2), 1959).

Some speculations about self-masses of elementary particles are presented.

539.12

8439. RELATION BETWEEN INTRINSIC PARITIES AND POLARIZATIONS IN COLLISION AND DECAY PROCESSES.
A.Bohr.
Nuclear Phys., Vol. 10, No. 4, 486-91 (April (1), 1959).

A simple rule is given which relates the polarizations of the particles involved in a collision process to the relative intrinsic parities in initial and final states. A similar rule applies to decay processes with conservation of parity. Some experiments are considered which could yield information on the intrinsic parities of hyperons and K-particles.

539.12

8440. ON PERIPHERAL INTERACTIONS OF ELEMENTARY PARTICLES. L.B.Okun and I.Ya.Pomeranchuk.
Nuclear Phys., Vol. 10, No. 4, 492-507 (April (1), 1959).

The peripheral interaction of strongly interacting elementary particles is adequately described phenomenologically by modern meson theory. To separate the contribution of the peripheral interaction it is proposed to determine from the experimental data the amplitudes of processes corresponding to large orbital momenta, since large orbital momenta correspond to large impact parameters. A comparison of such experimentally determined amplitudes with theoretically computed values makes it possible to determine a number of important quantities characterizing the strong interactions of elementary particles, such as the renormalized interaction constants of π-mesons with nucleons and hyperons, the renormalized interaction constants of two π-mesons, of a π-meson and a K-meson, etc.

539.12 : 530.145

8441. SEARCH FOR DIRAC MONOPOLES.
H.Bradner and W.M.Isbell.
Phys. Rev., Vol. 114, No. 2, 603-4 (April 15, 1959).

Nuclear emulsions were used to establish the following upper limits for the production of Dirac monopoles by 6.3 BeV protons: If poles of protonic mass are produced by direct nucleon–nucleon collision, the production cross-section is less than 2×10^{-35} cm^2 per nucleon. If poles of protonic or lower mass are produced by direct or by secondary processes and are subsequently held in matter with a binding energy less than 3 eV, the production cross-section is less than 1.5×10^{-37} cm^2 per nucleon. If poles of protonic or lower mass are produced by direct or by secondary processes and are subsequently held in matter with a binding energy between 3 eV and 20 eV, the production cross-section is less than 10^{-40} cm^2 per nucleon.

539.12 : 612.014.482.4

SOME RADIOLOGICAL APPLICATIONS OF GAMMA-RAY TRANSPORT THEORY. See Abstr. 7700

539.12

8442. COHERENT COMPTON AMPLITUDE AT HIGH ENERGIES.
T.Erber.
Ann. Phys. (New York), Vol. 6, No. 4, 319-40 (April, 1959).

The real and imaginary parts of the coherent Compton scattering amplitude are connected by a dispersion relation. The existence of both members of this relation is established by an investigation of the high energy behaviour of the scattering amplitude. Using a sequence of asymptotic representations and generalized Stieltjes' inequalities for the matrix elements (constructed with Dirac wavefunctions) it is proved that in the high energy limit: (a) the real part of the scattering amplitude is bounded, and (b) the cross-sections for the photoelectric effect and s-state "bound" pair-production become equal.

539.12

8443. MULTIPLE PHOTON PRODUCTION IN COMPTON SCATTERING AND BREMSSTRAHLUNG.
R.C.Majumdar, V.S.Mathur and J.Dhar.
Nuovo Cimento, Vol. 12, No. 2, 97-105 (April 16, 1959).

The multiple photon production in Compton scattering at high energies is investigated from the Feynman—Dyson formalism of quantum electrodynamics. It is observed that the multiple Compton scattering cross-section is largest when the photons emitted are all soft except one and differs from the single Compton scattering by a multiplicative factor, which increases with increasing energy of the incident photon. The multiple cross-section for bremsstrahlung at high energies is then obtained by the Williams—Weizsäcker method. The emission of about four hard photons within an extremely narrow cone is shown to be a plausible estimate.

539.12

8444. RELATION BETWEEN CIRCULAR POLARIZATION AND ENERGY FOR EXTERNAL BREMSSTRAHLUNG FROM BETA-RAYS.
A.Bisi and L.Zappa.
Nuclear Phys., Vol. 10, No. 4, 331-47 (April (1), 1959).

The relation between circular polarization of the external bremsstrahlung quanta from β-rays of Y^{90} and their energy was investigated in Al, Cu, Ag, Pb. The degree of circular polarization was found very high; in particular, the end points of the four relations give a circular polarization $\bar{P}_{\gamma} = 0.94 \pm 0.05$ to which corresponds a longitudinal polarization of β-rays equal to $-(0.98 \pm 0.05)v/c$. A rough calculation was made in order to compare experimental results with present theories: the predicted relations appear to be lower than the experimental ones. A detailed account of the γ-polarimeter is given.

539.12 : 537.56

8445. ON THE APPROACH OF ELECTRONS TO EQUILIBRIUM.
S.L.Kahalas and H.C.Kashian.
Phys. of Fluids, Vol. 2, No. 2, 100-2 (March-April, 1959).

The relaxation of electrons to equilibrium in the absence of an external field is discussed for a slightly ionized gas in which elastic collisions predominate. The gas consists of electrons and neutral molecules having a Maxwellian interaction. Spatial diffusion is neglected as well as electron–electron interaction. The change of the electronic distribution function from a simple nonequilibrium distribution to a Maxwellian distribution is followed in time. Electron attachment to neutral molecules is briefly considered.

539.12 : 530.145

ELECTRON–MUON MASS DIFFERENCE. See Abstr. 7787

539.12 : 541.12

8446. CHEMICAL REACTIONS OF POSITRONIUM IN AQUEOUS SOLUTIONS. J.McGervey and S.DeBenedetti.
Phys. Rev., Vol. 114, No. 2, 495-7 (April 15, 1959).

An attempt to a preliminary but systematic study of the chemical properties of the element positronium is described. It is verified (in agreement with Green and Bell, Abstr. 8144 of 1957) that positrons react with nitrates; it is believed that this reaction is an oxidation process. It is found that positronium is not so readily attacked by the ions Cl^- and SO_4^{--}. In chloride and sulphate solutions positronium more effectively replaces the metals which are lowest in the electrochemical series: this result opens the possibility of determining the position of positronium in the electrochemical scale.

539.12

8447. THE PROPER FIELD OF A PHYSICAL NUCLEON.

Ning Hu.
Nuclear Phys., Vol. 12, No. 1, 87-102 (June (3), 1959).

The energy values of Tomonaga's intermediate coupling equation for a physical nucleon are obtained from the asymptotic solutions of the equation when the number of mesons is very large. The energy values can be determined immediately from the requirement that the asymptotic solutions should contain only positive integer powers of meson emission operators. The possibility that the asymptotic solution for the ground state will give a good description of the situation at small distances from the core of nucleons is discussed. The result is consistent with the view that the production of meson showers by high energy nucleon collisions is due to the shaking off of meson clouds during collisions. No inconsistency with the low energy experiments is introduced by this picture of shower production.

539.12

8448. NUCLEON CHARGE DISTRIBUTION IN FIXED-SOURCE THEORY. M.Collin.

C.R. Acad. Sci. (Paris), Vol. 248, No. 12, 1793-5 (March 23, 1959).
In French.

The charge distribution is calculated numerically from a formula given by Fubini (Abstr. 6351 of 1956) for fixed-source pion field theory. Compared with experiment, the result is unsatisfactory. R.J.N.Phillips

539.12

8449. STRANGE PARTICLE CONTRIBUTION TO THE MAGNETIC MOMENT OF THE NUCLEON. K.Kumar and S.N.Biswas.

Nuclear Phys., Vol. 9, No. 3, 446-8 (Jan. (1), 1959).

The contribution of the strong hyperon—K-meson—nucleon interaction to the nucleon magnetic moment is calculated, to the first order. In order to fit the observed values with pseudoscalar K-mesons one needs $g_\pi{}^2/4\pi = 9.6$ and $g_{KNY}{}^2/g_\pi{}^2 = 0.06$. If, however, the K-meson is assumed to be scalar, the last ratio becomes 0.016, which is perhaps too small, and $g_\pi{}^2/4\pi$ in this case is 11.3.

539.12

8450. NUCLEON SPECTRUM IN STRONG COUPLING THEORY.

L.F.Landovitz and B.Margolis.
Ann. Phys. (New York), Vol. 7, No. 1, 52-64 (May, 1959).

The energy levels of the nucleon in fixed source pseudoscalar theory are considered in the strong-coupling limit. In addition to the previously found levels with $t = j$, levels characterized by the integral quantum number y, $Y^2 = (T + J)^2$, are found in terms of a cutoff length of the order of the nucleon size, a quantity A of the order of $1/a^3$, the π meson mass and the meson—nucleon coupling constant.

539.12

8451. A POSSIBILITY OF INTERPRETING THE S-STAR.

E.Friedländer and E.Ruckenstein.
Rev. de Physique (Bucharest), Vol. 11, No. 2, 209-15 (1957).
In German.

The event found by Schein et al. (Abstr. 2810 of 1951) has been analysed by Friedlander (Abstr. 4773 of 1957). The present paper is a further elaboration of the latter. The event, a free nucleon—nucleon collision, is regarded as the result of meson exchange, i.e. effectively the product of two meson—nucleon collisions. In the centre-of-mass system of the nucleon—nucleon collision particles emitted forward, termed "positive" are produced at the periphery while backward "negative" particles are emitted in the central zone. The analysis is based on a relation of the form

$$\frac{dn}{d\Omega} \sim \left(\frac{d\epsilon}{d\Omega}\right)^{\delta} \text{ where } \delta = 0.8$$

between the energy density $\frac{d\epsilon}{d\Omega}$ and the particle density, $\frac{dn}{d\Omega}$, on the theories of Bhabha (Abstr. 7960 of 1953) and the multiplicity curve of Heisenberg [see Marshak, Meson Physics (1952)]. The calculated multiplicity, mean energy ϵ_c in the c.m. system, the inelasticity factor and an ϵ_c-weighted mean tangent of the emission angle are found to be in agreement with experiment. H.Motz

539.12 : 539.14

8452. QUASI-FREE NUCLEON—NUCLEON SCATTERING.

T.A.J.Maris.
Nuclear Phys., Vol. 9, No. 4, 577-84 (Jan. (2), 1959).

A simple approximation is decribed for the calculation of quasi-free proton—proton scattering using distorted incoming and outgoing waves. The method is applied to Li^7. The results show that in this light nucleus the refraction by the collective nuclear potential does not destroy the strong connection between the angular correlation of the emerging protons and the momentum distribution of the knocked-out proton in the nuclear shell concerned.

539.12

8453. PROTON—PROTON SCATTERING FROM 1.4 TO 2.4 MeV.

D.J.Knecht, S.Messelt, E.D.Berners and L.C.Northcliffe.
Phys. Rev., Vol. 114, No. 2, 550-9 (April 15, 1959).

Differential cross-sections for the scattering of protons by protons have been measured at energies of 1.397, 1.855 and 2.425 MeV over an angular range from 12° to 90° in the centre-of-mass system. Total uncertainties vary from about ±0.1% at large angles to ±0.3% at the smallest angles. A thorough investigation of sources of error has yielded cross-section values in disagreement with previously published values. A simple phase-shift analysis has been made. Without the inclusion of vacuum polarization contributions, a satisfactory fit is not obtained with only S-wave and effective nuclear P-wave phase shifts. With their inclusion, the data are fitted well by pure S-wave nuclear scattering. An upper limit on the magnitude of the effective nuclear P-wave phase shift is estimated at about 0.02° at these energies.

539.12 : 530.145

ON THE PROOF OF DISPERSION RELATIONS FOR INELASTIC SCATTERING. See Abstr. 7802

539.12

8454. PROTON—PROTON SCATTERING WITH PARITY AND TIME-REVERSAL NONINVARIANCE. A.E.Woodruff.

Ann. Phys. (New York), Vol. 7, No. 1, 65-83 (May, 1959).

Develops a formalism to treat some of the effects of a hypothetical breakdown of parity and time-reversal invariance in the proton—proton interaction. The first two sections show how the usual parametrization of the S-matrix (in terms of phase shifts and mixing parameters) must be extended to include a description of such violations. The third section discusses some of the experiments which could detect these violations, if they existed, and the final part extends the general form of the p—p potential. The formalism is applied to two experiments testing time-reversal invariance.

539.12 : 537.56

8455. CHARGE TRANSFER FOR PROTONS IN H_2.

R.Curran, T.M.Donahue and W.H.Kasner.
Phys. Rev., Vol. 114, No. 2, 490-5 (April 15, 1959).

A precise measurement of the electron capture cross-section for protons in H_2 is reported for proton energies between 2.4 and 60 keV. The method involves collection of the residual ions by a sequence of identical condensers. The same scattering chamber is also used for the measurement of σ_{01} and $(\sigma_{01} + \sigma_{10})$. The recent measurements of Stier and Barnett (Abstr. 8259 of 1956) are in close agreement with these results.

539.12 : 530.145

8456. n—p AND p—p SCATTERING FROM CASE—PAIS MODEL IN THE ENERGY-RANGE 91 MeV TO 437 MeV.

S.Mukherjee and M.K.Pal.
Indian J. Phys., Vol. 31, No. 8, 415-30 (Aug., 1957).

A two-body potential consisting of even-parity central and tensor interactions with Yukawa radial dependence, and a Case—Pais type spin—orbit interaction with adjustable exchange dependence, were used to calculate n—p and p—p cross-sections in the Born approximation over a wide range of energies and angles. A set of values of parameters in the potential was obtained corresponding to the best fit with experimental curves. It was found that though these "best fit" parameters reproduce n—p cross-section satisfactorily from 91 to 400 MeV, they can give the observed isotropy in case of p—p scattering in the range 90° to 35° c.m. angles only up to 345 MeV, beyond which too much forward scattering is predicted. A deduction of the Born approximation scattering formulae using Racah's tensor operator formalism and Wigner's D-matrix is given.

539.12

8457. MEASUREMENT OF THE NEUTRON LIFE-TIME.

A.N.Sosnovsky, P.E.Spivak, Yu.A.Prokofiev, I.E.Kutikov and Yu.P.Dobrinin.
Nuclear Phys., Vol. 10, No. 4, 395-404 (April (1), 1959).

The half-life of the neutron was measured and found to be 11.7 ± 0.3 min.

539.12 : 539.17

8458. ANGULAR DISTRIBUTION OF PHOTO-NEUTRONS PRODUCED BY 17 MeV X-RAYS.

T.Asada, M.Masuda, M.Okumura and J.Okuma.
J. Phys. Soc. Japan, Vol. 13, No. 1, 1-4 (Jan., 1958).

The angular distributions of photo-neutrons from lead, copper, aluminium and beryllium were measured by using bremsstrahlung of maximum energy of 17 MeV from a betatron. The neutron detector is ZnS—paraffin—Lucite light guide button. The results are $1 + (1.29 \pm 0.53)\sin^2\theta$, $1 + (1.6 \pm 0.8)\sin^2\theta$, $1 + (0.17 \pm 0.06)\sin^2\theta$, $1 + (0.30 \pm 0.11)\sin^2\theta$ for beryllium, aluminium, copper and lead.

539.12

8459. THE THEORY OF n—d SCATTERING WITH TENSOR FORCES. L.M.Delves and D.Brown.

Nuclear Phys., Vol. 11, No. 2, 432-43 (May (3), 1959).

The scattering of neutrons by deuterons at energies below 3.5 MeV is investigated in an approximation including the effects of both the tensor force and the distortion of the deuteron by the neutron. The distortion is found to be small at these energies in the doublet state, but not in the quartet state. Angular distribution and polarization curves for the neutron are given as a function of energy, and the second order spin moment of the deuteron calculated at 3.25 MeV neutron energy. Agreement with experiments where these exist is reasonable. Polarizations of the order of 10% are predicted.

539.12 : 539.2

NEUTRON—PHONON INTERACTION IN SOLIDS.
See Abstr. 7494

539.12

8460. BOUNDARY CONDITIONS OF THE NEUTRON DIFFUSION AT THE EDGES OF AIR SPACES. D.Bünemann.

Atomkernenergie, Vol. 2, No. 6, 201-3 (June, 1957). In German.

Despite the failure of the diffusion theory in vacuum and air spaces, useful transfer conditions across these spaces can be obtained by a first approximation of the transport theory. The connection between the neutron flux and currents at corresponding points on either side of the space is obtained; from this the transfer conditions are obtained for spherical and cylindrical symmetry.

D.H.Lord

539.12

8461. ON THE ANISOTROPY OF A HETEROGENEOUS MEDIUM WITH RESPECT TO THE DIFFUSION OF NEUTRONS. I. L.Trlifaj.

Czech. J. Phys., Vol. 7, No. 4, 397-409 (1957).

Equations are derived for the diffusion of monoenergetic neutrons in a stratified heterogeneous medium. The neutron sources are plane and are located at infinity. The problem of homogenization and anisotropy of the heterogeneous medium is solved on the assumption of microscopic isotropy of scattering of the neutrons. The problem is solved quite generally (general position of the source, active and inactive medium). Comparisons with other work are made.

539.12

8462. ON THE ANISOTROPY OF A HETEROGENEOUS MEDIUM WITH RESPECT TO THE DIFFUSION OF NEUTRONS. II.

L.Trlifaj.
Czech. J. Phys., Vol. 7, No. 5, 523-32 (1957).

Previous results (see preceding abstract) are used to investigate the anisotropy of the diffusion of neutrons in a stratified heterogeneous medium with (total) cylindrical and spherical symmetry. A method developed by the author is employed to carry out homogenization of the stratified heterogeneous medium which scatters the neutrons anisotropically for each elementary act of scattering. The plane source at infinity is at the same time parallel to the layers.

539.12 : 539.17

8463. THERMALIZATION OF NEUTRONS IN INFINITE HOMOGENEOUS SYSTEMS. N.Corngold.

Ann. Phys. (New York), Vol. 6, No. 4, 368-98 (April, 1959).

The Boltzmann transport equation describing the steady state distribution in energy of fast neutrons which have been "thermalized" in a moderator, is analysed. The principal result of the analysis is an asymptotic series solution in terms of powers of (kT/E) whose coefficients depend upon the important physical parameters characterizing the system. The general solution is elucidated by application to thermalization by a monatomic gas.

539.12

8464. ABSOLUTE STANDARDIZATION OF RADIOACTIVE NEUTRON SOURCES. I. ACTIVATION OF MANGANESE BATH.

K.W.Geiger and G.N.Whyte.
Canad. J. Phys., Vol. 37, No. 3, 256-62 (March, 1959).

The neutron emission rate of a Ra—α—Be source of the National Research Council was measured by moderating the neutrons in manganese sulphate solution surrounding the source. Some of the thermal neutrons captured in the bath produce Mn^{56}, and the neutron emission rate is found from an absolute determination of the resulting activity. A number of corrections are discussed in detail. The value of $(3.22 \pm 0/05) \times 10^6$ neutrons per second found for the neutron emission rate shows satisfactory agreement with the results of intercomparison with the primary neutron standard of the National Bureau of Standards, and allows a tie-in with a series of international comparisons of primary neutron sources.

539.12

8465. ABSOLUTE STANDARDIZATION OF RADIOACTIVE NEUTRON SOURCES. II. THE USE OF THE $F^{19}(\alpha,n)Na^{22}$ REACTION. K.W.Geiger.

Canad. J. Phys., Vol. 37, No. 5, 550-6 (May, 1959).

Fluorine has only one stable isotope, F^{19}. If neutrons are produced by the $F^{19}(\alpha,n)Na^{22}$ reaction the neutron output can be calculated from the yield of the resulting radioactive Na^{22}. The growth of Na^{22} (half-life, 2.58 years) was measured in a neutron source consisting originally of 1.6 curies Po^{210} mixed with CaF_2 powder. Since Na^{22} is a positron emitter, discrimination against γ-rays from Po^{210} and from nuclear reactions could be achieved by detecting the two positron annihilation quanta in coincidence. The Na^{22} growth was followed over 20 months and is in agreement with the theoretical growth curve. Comparison with a calibrated Na^{22} source yielded a neutron emission rate of $(10.70 \pm 0.25) \times 10^4\ \mathrm{sec}^{-1}$. This resulted in a neutron emission rate of $(3.16 \pm 0.10) \times 10^6\ \mathrm{sec}^{-1}$ for the Ra—α—Be source of the National Research Council, in good agreement with $(3.22 \pm 0.05) \times 10^6\ \mathrm{sec}^{-1}$ obtained by a neutron thermalization method.

539.12 : 539.17

8466. TOTAL NEUTRON YIELDS FROM LIGHT ELEMENTS UNDER PROTON AND ALPHA BOMBARDMENT.

J.H.Gibbons and R.L.Macklin.
Phys. Rev., Vol. 114, No. 2, 571-80 (April 15, 1959).

Total neutron production cross-sections were measured for targets of D, T, Li^7, Be^9, B^{11}, C^{13}, C^{14} and F^{19} under proton bombardment and of Li^7, Be^9, B^{10}, and Si^{29} under alpha-particle bombardment. Energy ranges covered differ, but were contained between threshold and 5 MeV for protons and between threshold and 9 MeV for alphas. In several cases cross-sections for the inverse reactions, (n,p) and (n,α), were computed and compared, where available, with direct measurements.

539.12

8467. SIMPLE PULSED NEUTRON SOURCE BASED ON CROSSED-FIELD TRAPPING. J.D.Gow and L.Ruby.

Rev. sci. Instrum., Vol. 30, No. 5, 315-17 (May, 1959).

A simple pulsed neutron source has been constructed which consists of an anode formed by a cylindrical-shell permanent magnet and of two disk cathodes. One of the cathodes forms the neutron-producing target and the device is exhausted adjacent to the other. In operation, the anode is pulsed positive at 140 kV for 1 μsec at up to 200 pulses per sec. Continuous operation has also been achieved in a slightly different configuration. Ions are produced adjacent to the anode in a toroidal trapping region which exists as a result of the crossed electric and magnetic fields. The ionization is enhanced by the action of electrons reflecting through the inside of the magnetic shell. As a consequence of this trapping, large fluxes of soft X-rays are created which may be injurious to personnel.

539.12

8468. A PROPOSED STRONG INTERACTION OF MUONS.

G.Marx and K.L.Nagy.
Nuclear Phys., Vol. 12, No. 1, 125-32 (June (3), 1959).

The existence of a moderately strong universal interaction between baryons—K-mesons and muons—K-mesons has been assumed. This assumption may explain the anomalously large mass of muons. The interaction further naturally gives rise to several other effects, e.g. to a short range strong singular muon—nucleon potential. These effects do not seem to contradict the experiments.

539.12 : 537.591.3

8469. THE MULTIPLE SCATTERING OF COSMIC-RAY MESONS IN LEAD.

O.C.Allkofer, E.Bagge, P.G.Henning and L.Schmieder.
Atomkernenergie, Vol. 2, No. 3, 88-93 (March, 1957). In German.

The scattering of muons, of energy estimated as ≥ 235 MeV, in thicknesses of 1, 3, and 5 cm Pb, was measured by means of a spark counter telescope. It is concluded that the results are in agreement with Molière's theory of multiple scattering.

E.W.Kellermann

539.12

8470. SCATTERING OF μ-MESONS IN LEAD.

A.I.Alikhanian and F.R.Arutyunian.
Nuclear Phys., Vol. 10, No. 3, 244-55 (March, 1959).

μ-mesons with momenta between 1.0 and 1.8×10^8 eV/c were studied in 7 mm lead plates. The experimental angular distribution is compared with the theoretical curve for multiple scattering which takes into account the finite dimensions of the nucleus. It is shown that after introduction of all relevant corrections the experimental data satisfactorily agree with the calculations.

539.12

8471. SCATTERING OF μ-MESONS WITH MOMENTA OF ABOUT 100 MeV/c IN COPPER AND IRON.

V.G.Kirillov-Ugryumov, B.A.Dolgoshein, A.M.Moskvichov and L.P.Morozova.
Nuclear Phys., Vol. 11, No. 2, 357-67 (May (3), 1959).

Scattering of μ-mesons was studied in 4 mm copper plates (μ-meson momenta between 85 and 144 MeV/c) and iron plates (μ-meson momenta between 81.2 and 135 MeV/c). The μ-meson angular distribution derived from 2350 scattering events satisfactorily agrees with the distribution for a point nucleus.

539.12

8472. MUON CAPTURE IN CERTAIN LIGHT NUCLEI.

A.Fujii and H.Primakoff.
Nuovo Cimento, Vol. 12, No. 4, 327-55 (May 16, 1959).

The rates of the muon capture reactions: $\mu^- + He^3 \rightarrow H^3 + \nu$, $\mu^- + Li^6 \rightarrow He^6 + \nu$, $\mu^- + C^{12} \rightarrow B^{12} + \nu$, with the daughter nuclei formed in their ground states, are calculated assuming "universality" between muon—bare-nucleon and electron—bare-nucleon coupling constants. The "induced" pseudoscalar interaction and the additional terms arising from the assumption of a "conserved vector current" are included in the muon—nucleon effective Hamiltonian. The ratios of the nuclear matrix elements for the muon captures and for the corresponding β-decays are first estimated in an approximately "model independent" fashion using appropriate nuclear proton density distribution functions and then evaluated in more detail on the basis of variational trial wave-functions for He^3, H^3, and of LS coupling and jj coupling shell model wave-functions (with configuration mixing) for Li^6, He^6, and C^{12}, B^{12}, respectively. The calculated capture rate for $\mu^- + C^{12} \rightarrow B^{12} + \nu$ is in agreement with experiment — experiments however are not yet available in the other two cases.

539.12 : 539.17

μ^--CAPTURE IN LIGHT NUCLEI. See Abstr. 7367

539.12

8473. ON THE POSSIBLE EXISTENCE OF A SECOND NEUTRAL π-MESON.

A.Baldin and P.Kabir.
Dokl. Akad. Nauk SSSR, Vol. 122, No. 3, 361-4 (1958). In Russian.

See Abstr. 541 (1959). It is suggested that the discrepancy between the Panofsky ratio and the cross-sections for threshold photomeson production and low-energy charge-exchange scattering may be removed by postulating the existence of such a particle without contradicting any of the known experimental data. The reaction $d + d \rightarrow He^4 + \pi^0$ is proposed as a test for the existence of the new particle with isotopic spin zero.

P.K.Kabir

539.12

8474. OBSERVATION OF THE BREMSSTRAHLUNG OF π-MESONS INTERACTING WITH NUCLEI.

M.F.Lomanov, A.G.Meshkovsky, Ya.Ya.Shalamov, V.A.Shebanov and A.F.Grashin.
Nuclear Phys., Vol. 10, No. 3, 283-93 (March, 1959).

Nuclear force bremsstrahlung of π^+-mesons was observed in a freon bubble chamber in which 80-300 MeV π^+-mesons interacted with carbon, fluorine and chlorine nuclei. In the indicated energy range the bremsstrahlung cross-section for inelastically and elastically scattered π^+-mesons as derived from 20 scattering events was found to be $(4.5^{+1.2}_{-2.0}) \times 10^{-27}$ cm^2 per fluorine nucleus. Three cases of bremsstrahlung involved absorption of the π^+-mesons by the nucleus; in two cases of bremsstrahlung charge-exchange scattering of π^+-mesons on the nucleus occurred. The bremsstrahlung cross-sections for these various types of nuclear processes have been computed in the quasiclassical approximation. The values obtained from the formulae satisfactorily agree with the experimental results.

539.12

8475. PHOTOPRODUCTION OF TWO PIONS ON A NUCLEON.

P.Sergent.
C.R. Acad. Sci. (Paris), Vol. 248, No. 16, 2294-6 (April 20, 1959). In French.

This process is studied in fixed-source theory, in relation to π—N scattering, one-pion photoproduction and (π,2π) reactions.

R.J.N Phillips

539.12

8476. ANGULAR DISTRIBUTIONS OF PHOTOPIONS FROM HYDROGEN.

E.A.Knapp, R.W.Kenney and V.Perez-Mendez.
Phys. Rev., Vol. 114, No. 2, 605-11 (April 15, 1959).

An accurate measurement of the differential cross-section for the photoproduction of positive pions from protons was made at the Berkeley synchrotron for photon energies of 260 and 290 MeV. The mesons were produced in a thin-walled liquid-hydrogen target, and the meson-detection apparatus utilized the characteristic decay of the pion. The measurements were done in two steps, from 0° to 50° with equipment specifically designed to reduce a very high forward-angle positron background, and from 30° to 160° with equipment whose efficiency and solid angle could be accurately determined. The abrupt flattening of the observed cross-section in the region forward of 40° is due to "photoelectric ejection" of pions from the cloud surrounding the nucleon. The results are compared to the theory of photoproduction derived from the dispersion relations, and the agreement is satisfactory within the limitations of the theory.

539.12

8477. COULOMB EFFECTS IN BOSON EMISSION.

M.J.Moravcsik.
Phys. Rev., Vol. 114, No. 2, 621-5 (April 15, 1959).

The corrections in boson emission processes due to Coulomb forces between the two particles are considered. The usual "Coulomb penetration factor" is modified by relativistic and finite-size effects. Numerical results are given for the emission by a nucleon of pions and K mesons in S and P states. It is emphasized, however, that in the absence of precise knowledge about the mechanism of emission the present numerical results should be considered only approximate.

539.12

8478. STRANGE PARTICLE DECAYS AND THE UNIVERSAL V—A FOUR-FERMION INTERACTION.

S.Oneda.
Nuclear Phys., Vol. 9, No. 3, 476-97 (Jan. (1), 1959).

The branching ratios of various decay modes of K-meson are discussed on the basis of a universal vector and axial-vector four-fermion interaction. The simplest and most straightforward interpretation of the results leads to the following tentative conclusion: The (squared) coupling constant of the strangeness non-conserving baryon—lepton interactions, such as the $\Lambda^0 \rightarrow p + e^- + \bar{\nu}$ or $\Sigma^- \rightarrow n + e^- + \bar{\nu}$, is smaller than the usual Fermi coupling constant $(1.4 \times 10^{-49}\ \text{erg cm}^3)^2$ by, at least, one order of magnitude. This is rather consistent with the recent observations on the hyperon decays into leptons. Alternative possibilities which may enable one to avoid this conclusion are also discussed. An example is to expect strong final state interactions in the $K^0 \rightarrow \pi^+ + \pi^-$ decay. Also phenomenological estimates of the decay rates of $\Lambda^0 \rightarrow p + e^-\ (\mu^-) + \bar{\nu}$ from the experimentally known rates of $K \rightarrow \mu + \nu$ and $K \rightarrow \pi + e(\mu) + \nu$ decays are made. It is concluded that the computed lower limits of the rates are not in contradiction with the present experimental information.

539.12

8479. PRODUCTION AND DECAY OF THE STRANGE PARTICLES.

Ho An-shiang.
Scientia Sinica, Vol. 8, No. 5, 468-84 (May, 1959).

The cloud chamber used has a volume of 30 × 30 × 10 cm^3 in a magnetic field of 6200 G and is operated at a mountain altitude of 3185 m. In a set of 30 000 pairs of photographs taken, 105 decay events of neutral V-particles and 21 of the decay of charged particles were observed. It is seen that 16 events have been classified as due to the decay of Λ^0-particles, 26 as due to the decay of Λ^0-particles, 26 as due to the decay of θ_1^0-particles, one as θ_2^0-particle and

62 as nonclassified. The following properties of the Λ^0 and θ^0-particles were studied. (1) Q values and mean lifetimes; (2) the momentum distributions found for the Λ^0 and θ_1^0-particles have no significant difference from earlier results; (3) $N(\Lambda^0)/N(\theta_1^0) = 0.51 \pm 0.22$ (corrected number in lead); (4) the angular distributions of the decay products of the Λ^0 and θ_1^0-particles in the rest system have no marked asymmetry; (5) the lifetime of one θ_2^0-particle is estimated to be 10^{-9} sec in the rest system. The decay mode of this θ_2^0-particle is probably $\theta_2^0 \to \pi^- + \pi^+ + \pi^0$ or $\theta_2^0 \to \pi^\pm + \mu^\mp + \nu$.

539.12

8480. THE INTERACTIONS OF POSITIVE K-MESONS WITH NUCLEI IN PHOTOGRAPHIC EMULSION AT ENERGIES IN THE REGION (240-300) MeV. D.Keefe, A.Kernan, A.Montwill, M.Grilli, L.Guerriero and G.A.Salandin.
Nuovo Cimento, Vol. 12, No. 3, 241-63 (May 1, 1959).

Interactions of K^+-mesons with emulsion nuclei have been observed in a scan of 184 m of track. The analysis yielded information on scattering reactions K^+—p and K^+—n and charge-exchange reactions. An energy dependence of the three cross-sections up to 350 MeV was obtained from the collected data of different laboratories working with emulsion technique. The phase-shift analysis in the 300 MeV region show a contribution of T=0 state of the same order of magnitude as that of T=1 state. An interference seems to be present between the P-waves of the two states, depressing the K^+—n scattering cross-section and raising the charge-exchange cross-section.

539.12 : 530.145

BOUND STATES IN MESON PAIR THEORY. See Abstr. 7801

539.12

8481. ON NON-LEPTONIC DECAYS OF HYPERONS.
B.D'Espagnat and J.Prentki.
Nuclear Phys., Vol. 11, No. 4, 700-5 (June (2), 1959).

Some numerical estimates are made of various parameters entering in Σ and Λ decays. These are based on assumptions which, using the global symmetry formalism, lead to a general Hamiltonian for weak interactions relating nonleptonic decays of hyperons between each other.

539.12

8482. STUDY OF θ_1^0 PRODUCTION AND DECAY BY OBSERVATION OF ITS NEUTRAL DECAY MODE.
J.E.Osher, B.J.Moyer and S.I.Parker.
Phys. Rev., Vol. 114, No. 2, 612-20 (April 15, 1959).

The production of strange particles possessing neutral-pion decay products was investigated in proton bombardment of Bevatron targets. A well-collimated telescope counted energetic gamma photons originating within a few centimeters of the target. The position-dependent counting rate was determined by moving the telescope and collimation on a track parallel to the beam direction, and the resulting data were then compared to curves calculated from certain assumed kinematical models consistent with associated production. The counting rate and its variation with position were consistent with the identification of $\theta_1^0 \to 2\pi^0$, which implies even spin and even parity. The data also allow some gamma-ray contributions from $\theta^+ \to \pi^+ + \pi^0$, $\Sigma^+ \to p + \pi^0$, and $\Lambda^0 \to n + \pi^0$. The ratio of intensities from regions "upstream" to those "downstream" from the target implies a strongly peaked angular distribution, forward and backward, in the reference frame of the colliding nucleons which produce the θ_1^0.

539.12

8483. A STUDY OF Λ^0 AND θ^0 PARTICLES PRODUCED IN Pb AND Al. Lü Min, Cheng Jen-chi and Li Ho-nian.
Scientia Sinica, Vol. 8, No. 5, 485-509 (May, 1959).

Two experiments on V^0 particles were carried out with a multiplate cloud chamber during 1955-1957. A total of 550 V^0 particles were found. The 67 Λ^0 and 44 θ^0 particles are classified by using the $\alpha - \epsilon$ method. Among them 58 Λ^0 and 38 θ^0 were produced in Pb, 9 Λ^0 and 6 θ^0 were produced in Al. The following results have been obtained: (1) The decay angle in the centre of mass system of Λ^0 or θ^0 is uniformly distributed. The correlation angle between the production plane and the decay plane is distributed also uniformly. No information can be obtained to the effect that the spins of the V^0 particles are larger than $\frac{1}{2}$. (2) No asymmetry of angular distribution showing nonconservation of parity is seen for the decays of the Λ^0 particles produced in Pb. For Λ^0 produced in Al some indications of asymmetry are noted. (3) The hyperon tends to go backward in the associated production process from the consideration of the momentum spectrum and production angle distribution. (4) The following lifetimes are obtained:

$$\tau_{\Lambda^0} = 3.39 {+0.63 \atop -0.44} \times 10^{-10} \text{ sec}, \quad \tau_{\theta^0} = 0.86 {+0.26 \atop -0.16} \times 10^{-10} \text{ sec}.$$

(5) $N(\Lambda^0)/N(\theta^0) \sim 1.4$. (6) The total cross-section for strange particle production is estimated to be of the order of 0.8 mb/nucleon, for both Pb and Al. (7) The Pb nucleus is more effective than the Al nucleus for producing a V^0 particle, when one considers the percentage of the V^0 with respect to the total number of secondary particles.

539.12

8484. ANALYSIS OF THE Λ-HYPERNUCLEAR THREE-BODY SYSTEMS. B.W.Downs and R.H.Dalitz.
Phys. Rev., Vol. 114, No. 2, 593-602 (April 15, 1959).

An analysis of the Λ-hypernuclear three-body systems is made by a variational method with a six-parameter trial function. An upper bound for the strength of the Λ—nucleon interaction required to account for the observed binding of the T = 0 hypertriton ${}_\Lambda H^3$ is obtained. This upper bound is 10-20% (depending upon the value taken for the binding energy) lower than the previous estimate by the same authors. An improved quantitative estimate of the spin dependence of the Λ—nucleon interaction (neglecting the possible influence of three-body forces) is obtained from the results of this analysis and those of a previous analysis of ${}_\Lambda He^5$; from this estimate it follows that the existence of a bound Λ-nucleon system is strongly excluded. The analysis of the T = 1 triplet ${}_\Lambda He^3$, ${}_\Lambda H^3$, ${}_\Lambda n^3$ indicates that these systems are not expected to form bound states. It appears that the essential conclusions of this work would not be seriously affected if there exist moderately strong three-body forces arising from pion exchange processes.

539.12

8485. A NOTE ON THE DECAY OF THE Σ-HYPERON AND ITS ANTIPARTICLE. Chou,K.-C.
Nuclear Phys., Vol. 9, No. 4, 652-4 (Jan. (2), 1959).

Examines the information which may be derived from measurements of the branching ratios and angular correlation of Σ- and $\bar{\Sigma}$-decays.

539.12

8486. ON THE DETERMINATION OF THE PARITY OF HYPERONS AND K-MESONS. S.M.Bilenky and R.M.Ryndin.
Nuovo Cimento, Vol. 12, No. 2, 106-10 (April 16, 1959).

Possible methods for determining the relative parity of hyperons and K-mesons in the reactions with polarized proton beams are considered.

539.12

8487. PHENOMENOLOGICAL EIGENFUNCTIONS AND POTENTIALS FOR THE DEUTERON GROUND STATE. I-II.
L.Hulthén and L.T.Hedin.
K. Norske Vidensk. Selsk. Forhandl., Vol. 31, No. 3, 14-18; No. 4, 19-25 (1958 : publ. 1959).

Special functions with correct asymptotic behaviour and vanishing at r = 0, or a cut-off distance r_C, are adjusted to the deuteron data: binding energy, effective range, electric quadrupole moment and various values of D-state probability p_D. As expected, the main uncertainty in the eigenfunctions comes from inadequate knowledge of r_C and p_D. The corresponding potentials are derived from the Schrödinger equation and briefly discussed.

NUCLEUS

539.14

8488. THE γ-DEPENDENT PART OF THE WAVE FUNCTIONS REPRESENTING γ-UNSTABLE SURFACE VIBRATIONS.
D.R.Bès.
Nuclear Phys., Vol. 10, No. 4, 373-85 (April (1), 1959).

This is solved. The general solution is a linear combination of wave-functions belonging to a "basic set". The coefficients in this linear combination are expressed as polynomials in $\cos 3\gamma$. Some consequences of these solutions are discussed. In the appendix the equations for the coefficients are given in the cases $I \leq 6$, and the explicit solutions are constructed for $\lambda \leq 9$.

539.14

8489. THE EFFECTIVE NUCLEAR POTENTIAL.
T.H.R.Skyrme.
Nuclear Phys., Vol. 9, No. 4, 615-34 (Jan. (2), 1959).

An empirical analysis is made of the mean effective internucleon potential required in the shell-model description of nuclei, allowing for the presence of many-body effects as suggested by current theory. A consistent description is found in which the effective two-body interaction acts almost entirely in even states, and the many-body effects are simulated by a repulsive three-body contact interaction. The strength of the two-body interaction is consistent with that expressed by the free scattering matrix of the two-nucleon system, and that of the three-body interaction with the "rearrangement energy" calculated in the many-body theory.

539.14

8490. THE SPIN-ORBIT INTERACTION IN NUCLEI.
T.H.R.Skyrme.
Nuclear Phys., Vol. 9, No. 4, 635-40 (Jan. (2), 1959).

The analysis previously made of the average nuclear potential (see preceding abstract) is extended to consideration of the spin—orbit interactions. It has not been possible to find a satisfactory two-body interaction consistent with all the data; that suggested by the phase-shift analysis of nucleon—nucleon scattering is just within the region of possible forms.

539.14

8491. SOME DISTORTION EFFECTS IN THE NUCLEAR p-SHELL.
T.H.R.Skyrme.
Nuclear Phys., Vol. 9, No. 4, 641-9 (Jan. (2), 1959).

Some reasons are given for disliking the tensor-force explanation of the long lifetime of C^{14}. It is suggested that the composition of the ground state of N^{14} is influenced by distortion in such a way as to simulate the presence of a tensor interaction. Calculations made with a particularly simple form of unitary distortion operator give an effect of the correct sign and magnitude.

539.14

8492. SIMPLIFIED INTERMEDIATE-COUPLING PROCEDURE IN THE 1p-SHELL. D.Kurath and L.Pičman.
Nuclear Phys., Vol. 10, No. 4, 313-30 (April (1), 1959).

Intermediate-coupling wave-functions are constructed by applying Elliott's generating procedure to intrinsic wave-functions based on Nilsson's deformed-potential calculation. These are compared with wave-functions from an intermediate-coupling calculation with a two-body central interaction. A strong overlap is found between the groups of low-lying states obtained by these two methods of calculation.

539.14

8493. DOUBLET SPLITTINGS IN NUCLEI AND THE STRONGLY CORRELATED NUCLEAR WAVE FUNCTIONS.
J.Sawicki and R.Folk.
Nuclear Phys., Vol. 11, No. 2, 368-86 (May (3), 1959).

The nucleon—nucleus LS coupling is calculated using the Brueckner type of theory and the strongly correlated nuclear core density obtained from Jastrow's theory applied to the finite nucleus. The two-body potentials are replaced by the two-body scattering operators calculated from the potentials of Gammel and Thaler and of Signell and Marshak. It was possible to avoid many approximations often made in calculations of this type and thus some important correction to the leading Thomas-like term are included. The general theory is applied to the O^{17} problem with Dabrowski variational trial functions of O^{16} to calculate the core density. Both the correct sign and the correct order of magnitude of the doublet splitting of O^{17} are obtained for both two-body potentials, and so this theory provides no clear distinction between these potentials.

539.14

8494. EVIDENCE FOR THREE-BODY VECTOR FORCES IN LIGHT NUCLEI. A.M.Feingold.
Phys. Rev., Vol. 114, No. 2, 540-9 (April 15, 1959).

The splittings of the P-doublet states of Li^7 and N^{15}, and the D-doublet states of O^{17}, are calculated with phenomenological two-body vector forces of both Gaussian and Yukawa shapes with arbitrary ranges and exchange character. It is found to be impossible to fit the experimental data with a two-body force of fixed strength, in agreement with Pearse's calculations based on a relativistic two-body vector force. The splittings are then calculated with a phenomenological three-body vector force of the type expected to arise from higher order effects of the tensor force. The predicted ratio of the P doublet splitting in N^{15} to that in Li^7 is found to be quite insensitive to the range or shape of the three-body force, and in excellent agreement with experiment, provided that the exchange character of the force is not chosen close to the Serber mixture. The O^{17} D-doublet splitting, while somewhat more sensitive to the choice of range and exchange mixture, can also be fitted simultaneously, with a wide variety of three-body vector potentials. An attempt is then made to derive the parameters of the three-body vector force from the Gammel—Thaler tensor force parameters, but the resultant force has the wrong exchange character, and is also much too weak, to fit the experimental data. This is mainly due to the Serber-like exchange character of the Gammel—Thaler tensor force. A moderate increase in the strength or range of the odd-state tensor force would give a satisfactory three-body vector force. The splitting of the ^{3}D states of Li^6 is also examined. Here one-, two-, and three-body vector forces all predict too small a splitting, when the strength of the interaction is normalized to the Li^7 P-doublet splitting, For the three-body vector force, however, there exists the possibility that the strength parameter is greater for Li^6 than for Li^7, which would improve the fitting.

539.14

8495. SURFACE CORRECTIONS TO THE FERMI—THOMAS STATISTICAL THEORY. M.A.Naqvi.
Nuclear Phys., Vol. 10, No. 3, 256-82 (March, 1959).

The Hartree—Fock equations are written in matrix form with the aid of the Dirac density matrix. The Fermi—Thomas theory is generalized so that these equations are explicitly satisfied for the diagonal elements and those lying near the diagonal. This procedure modifies the functional relationship between the energy and particle densities by introducing a dependence of the former on the derivatives of the particle density and on the nature of the collective field. It is shown by a simple example that the modifications appear to bring the statistical theory into better agreement with the empirically known results for the case of a local average field. They also provide a method of estimating the effects of the non-locality of the average field on the surface characteristics of a many-body system.

539.14

8496. A SIMPLE MODEL OF A SYSTEM POSSESSING ROTATIONAL STATES. S.Goshen (Goldstein) and H.J.Lipkin.
Ann. Phys. (New York), Vol. 6, No. 4, 310-18 (April, 1959).

A simple one-particle model is used to investigate whether a real physical rotation necessarily exists in systems having rotational energy spectra, i.e. spacings which are proportional to J(J + 1). The model has rotational energy spectra and can be solved exactly in terms of rotational and intrinsic coordinates. However, many properties of these states are quite different from those expected in a rotational band. The physical meaning of the model is discussed, using a classical treatment. A real physical rotation is demonstrated, but the intrinsic motions of states within the same band are not simply related. The possibility of the presence of such effects in real nuclei is considered.

539.14

8497. ISOTOPE SHIFT AND CHANGES OF NUCLEAR RADIUS.
A.R.Bodmer.
Nuclear Phys., Vol. 9, No. 3, 371-90 (Jan. (1), 1959).

A new derivation of the expression for the nuclear charge distribution dependent isotope shift (I.S.) is given. This derivation shows clearly what approximations are made. The result, essentially the same as already obtained previously by the author, is as simple as the perturbation theory expression for the I.S. but is independent of the limitations of this. It depends on the charge distribution as a whole only through the root-mean-square radius, $\langle r^2\rangle^{\frac{1}{2}}$ and on the difference of charge distribution between isotopes only through $\delta\langle r^2\rangle^{\frac{1}{2}}$. The implications of the electron scattering results for the I.S. are considered both for its dependence on $\langle r^2\rangle^{\frac{1}{2}}$ and on $\delta\langle r^2\rangle^{\frac{1}{2}}$. A renewed discussion is given of the effect of nuclear compressibility on the I.S. first considered by Wilets, Hill and Ford. For this the dependence of the symmetry energy on the density is shown to be as important as the Coulomb energy. Thus the I.S. cannot be uniquely related to the compressibility coefficient of nuclear matter but may now however be used to obtain information about the density dependence of the symmetry energy. The implications of the I.S. data for changes of radius between isotones and between nuclei along the mass valley are also briefly considered.

539.14

8498. NUCLEAR SHELL MODEL AND PSEUDOSCALAR POTENTIAL. E.Merzbacher.
Helv. phys. Acta, Vol. 30, No. 6, 513-14 (1957).

A proof that the Dirac equation with a pseudoscalar potential has no bound solutions. R.J.N.Phillips

539.14

8499. HOLES IN THE 1p SHELL IN THE UNIFIED MODEL. C.S.Warke and G.Abraham.
Nuclear Phys., Vol. 10, No. 3, 306-10 (March, 1959).

The negative parity levels in nuclei of mass number A = 13, 17, 19 are derived on the basis of a hole in the $1p_{3/2}$ or $1p_{1/2}$ shells weakly coupled to the surface oscillations.

539.14

8500. PARTICLE–HOLE CONJUGATION IN THE SHELL MODEL. J.S.Bell.
Nuclear Phys., Vol. 12, No. 1, 117-24 (June (3), 1959).

The idea of particle–hole conjugation is expounded in the language of second quantization. Results of Racah (Abstr. 634 of 1943) are rederived and in particular a theorem important for the classification of states of half-filled shells.

539.14 : 539.17

8501. CLASSICAL AND QUANTAL FLUX IN THE OPTICAL MODEL. R.M.Eisberg, I.E.McCarthy and R.A.Spurrier.
Nuclear Phys., Vol. 10, No. 5, 571-82 (April (2), 1959).

In a semi-classical theory, direct interactions are described by two-body collisions at points in the nucleus. To describe the initial conditions for the collision one needs to know the momentum of the incident particle, the probability of finding it at the collision point, and the probability of a collision occurring. These were calculated first by describing the particles by classical rays which can be refracted and absorbed by an optical potential. In the process of making these calculations it was found that the transmission coefficients for a particle following a given ray through the nucleus were not always in agreement with transmission coefficients calculated by quantum mechanics for the corresponding partial wave. To investigate this point the average flux and its divergence were calculated from the classical ray picture. The values of these quantities were found to be close to those of corresponding quantities calculated by quantum mechanics in the same potential where they are significantly large, but large differences were found where the flux and divergence are small. One concludes that the probability of a particle appearing at a point in the nucleus is, in general, not uniquely connected with the corresponding probability of finding it at a point outside, as is implied by a ray calculation. That is, the disturbance at any interior point is influenced by several partial waves. However, a classical flux calculation is sufficiently accurate to be useful in certain applications.

539.14 : 539.17

FLUX OF PARTICLES IN THE OPTICAL MODEL. See Abstr. 8610

539.14

8502. ON THE SUPERFLUID STATE OF THE ATOMIC NUCLEUS. V.G.Soloviev.
Nuclear Phys., Vol. 9, No. 4, 655-64 (Jan. (2), 1959).

The variation principle proposed by Bogoyubov and the mathematical methods developed in the theory of superconductivity are employed to study the properties of the atomic nucleus. Weak interactions between protons (or neutrons) located in the same shell are treated on the basis of a nuclear model in which nucleons of the closed internal shells are assumed to produce a centrally symmetrical field which is somewhat distorted by nucleons in the outer shell. It is shown that the interaction between protons in an outer shell gives rise to a superfluid state of the nucleus, the main role being played by interactions between protons with equal and opposite projections of the angular momenta on the nuclear symmetry axis. The energy of the ground superfluid state and first excited state is evaluated and it is shown that in the case of an even number of protons in the shell, an energy gap between the superfluid and first excited states should exist, whereas no such gap exists if the number of protons is odd. This permits one to explain the energy gap in heavy even nuclei. Conditions for the appearance of a superfluid state in an atomic nucleus have been obtained. They reduce to the requirement that attractive forces predominate between interacting protons located in the same shell near the Fermi surface energy. The critical temperature for the phase transition of a nucleus from the superfluid to normal state has been determined.

539.14

8503. ON MOMENTS OF INERTIA OF STRONGLY DEFORMED ODD-A NUCLEI. O.Prior.
Ark. Fys., Vol. 14, Paper 28, 451-72 (1958).

An attempt to relate the differences between the experimental moments of inertia of odd-A nuclei and those of the even–even nuclei of mass number A-1 to the orbital contributions of the last odd nucleons. R.J.N.Phillips

539.14

8504. ON THE DEFORMABILITY OF NUCLEAR CORES. Z.Szymański.
Nuclear Phys., Vol. 11, No. 2, 454-8 (May (3), 1959).

The self-consistent deformation of the nuclear core induced by an outside nucleon is calculated. It is shown that this can account for the weak collective effects of heavy nuclei near closed shells.

539.14

8505. ON THE DISTRIBUTION OF PROTONS IN THE NUCLIDE ^{12}C. L.R.B.Elton, B.J.Hiley and R.Price.
Proc. Phys. Soc., Vol. 73, Pt. 1, 112-14 (Jan., 1959).

The proton density distribution in C^{12} is analysed in terms of the Fermi form factor

$$\rho(r) = \rho_F/\{1 + \exp[4.4(r-c)/t]\},$$

using high-energy electron scattering data. The central density is close to an average value for heavier nuclides, but the skin thickness t is less than for the latter. R.J.N.Phillips

539.14 : 530.162

INDEPENDENT-PARTICLE SYSTEM HAVING COLLECTIVE PROPERTIES. See Abstr. 7814

539.14

8506. THE EFFECT OF PHENOMENOLOGICAL THREE-BODY FORCES ON THE SATURATION OF BINDING ENERGIES OF LIGHT NUCLEI. S.Sanatani.
Z. Phys., Vol. 153, No. 4, 508-22 (1959).

The effect of a repulsive non-exchange Gaussian three-body potential is investigated in first-order perturbation theory. Nuclei of mass 15, 16, 17 and 40 are considered, assuming shell-model wave-functions with L–S coupling and a two-body interaction that includes exchange and spin–orbit forces but no hard core. It proves impossible to choose the three-body force parameters to fit both nuclear radius and binding energy in this model. R.J.N.Phillips

539.14

8507. COLLECTIVE CO-ORDINATES FOR NUCLEAR ROTATION. A.Bohr and B.R.Mottelson.
K. Norske Vidensk. Selsk. Forhandl., Vol. 31, No. 12, 71-9 (1958: publ. 1959).

The co-ordinate transformation leading to an approximate separation of the nuclear Hamiltonian into rotational and intrinsic parts is considered. It is found that the condition of optimum separation leads to an expression for the moment of inertia, equivalent to that of nucleons moving in an external rotating potential. For simplicity, the considerations are restricted to a two-dimensional system.

539.14 : 539.18

8508. ZEEMAN INVESTIGATIONS OF CURIUM-242. J.C.Hubbs, R.Marrus and J.O.Winocur.
Phys. Rev., Vol. 114, No. 2, 586-9 (April 15, 1959).

The atomic-beam magnetic-resonance method was used to investigate 163 day Cm^{242}. The spin of this even–even nuclide is found to be zero. Four low-lying electronic energy levels are found and the Lande g-factors are measured to be $g_{J_2} = 2.561 \pm 0.003$, $g_{J_3} = 2.000 \pm 0.003$, $g_{J_4} = 1.776 \pm 0.002$ and $g_{J_5} = 1.671 \pm 0.003$. No direct measurement can be made of the angular momenta of these levels, but other considerations contained in the text make highly probable the J values indicated in subscripts and arising from the electronic configuration $(5f)^7\,(6d)^1\,(7s)^2$.

539.14

8509. EFFECT OF CONFIGURATION MIXING ON MAGNETIC MULTIPOLE RADIATION. K.K.Gupta and R.D.Lawson.
Phys. Rev., Vol. 114, No. 1, 326-32 (April 1, 1959).

Expressions for the matrix element governing the emission of magnetic multipole radiation are given. The effect of weak configuration mixing and the small additional contribution to proton matrix elements (~ 5%) arising from the nuclear spin-orbit interaction are considered. For M4 transitions, even in nuclei near closed shells, the theoretical matrix elements derived from pure configurations are too large by a factor of two. The effect of configuration mixing reduces these. Choosing a δ-function interaction of reasonable strength leads to a reduction of ~ 25% in the matrix element for $1g_{9/2} \rightarrow 2p_{1/2}$ transition in Y^{89}. The $(2p_{1/2})^{-1} \rightarrow (1g_{9/2})^{-1}$ transition Sr^{87} is reduced close to the required 50%. The $1h_{11/2} \rightarrow 2d_{3/2}$ matrix element becomes ~ 25%. However, there are no data available for the nucleus Sn^{115}, with which one would like to make comparison. Finally, the $(1i_{13/2})^{-1} \rightarrow (2f_{5/2})^{-1}$ transition in Pb^{207} has its matrix element reduced by only ~ 6%. Although the reduction in Y^{89} is somewhat too small, one cannot make a positive statement that configuration mixing is incapable of explaining the experimental result since a two-body force of a more realistic type may close the gap between theory and experiment. However, for Pb^{207} there seems no doubt that other effects, for example, meson currents, must be incorporated.

539.14

8510. ELECTRIC DIPOLE MOMENT ASSOCIATED WITH OCTUPOLE VIBRATIONS OF A SPHEROIDAL NUCLEUS (ADDITIONAL REMARKS). A.Bohr and B.R.Mottelson.

Nuclear Phys., Vol. 9, No. 4, 687-8 (Jan. (2), 1959).

See Abstr. 5270 (1958).

539.14

8511. QUADRUPOLE MOMENT OF Nb^{93} AND TEST OF THE HYPERFINE STRUCTURE FORMULAS. K.Murakawa.

J. Phys. Soc. Japan, Vol. 13, No. 1, 101-8 (Jan., 1958).

The hyperfine structure (h.f.s.) of the spectrum of Nb I was studied by means of a liquid-air-cooled hollow cathode discharge tube and a Fabry—Perot etalon. The quadrupole moment of Nb^{93} was deduced to be −0.29 barn and −0.20 barn from the levels $4d^35s^2\ {}^4F_{3/2}$ and $4d^45s\ {}^6D_{3/2}$ respectively, in which no shielding correction is included. Assuming that the shielding correction in this case is zero, $Q(Nb^{93}) = -0.2 \pm 0.1$ barn, is obtained. The interval factors of the levels $4d^35s^2\ {}^4F_{3/2,5/2,7/2,9/2}$ and $4d^45s\ {}^6D_{3/2,5/2,7/2,9/2}$ were measured and compared with h.f.s. formulae, and a small but definite discrepancy was detected.

539.14

8512. ELECTRIC QUADRUPOLE ENHANCEMENT NEAR O^{16}.

G.Barton.

Nuclear Phys., Vol. 11, No. 2, 466-74 (May (3), 1959).

The core enhancement of E2 effects near O^{16} is calculated on the shell model with configuration mixing. The physical basis of the method is clarified by tracing its connection with Hartree—Fock theory and it is shown that it allows only for the static distortion of the core, but not for the genuine dynamic correlations between the odd particle and the core protons. The calculations cannot correlate, let alone explain, the data, which are therefore interpreted as evidence for the importance of long range correlations in the nucleus.

539.14 : 539.12

8513. MULTIPLE NEUTRON CAPTURE IN THE MIKE FUSION EXPLOSION. A.G.W.Cameron.

Canad. J. Phys., Vol. 37, No. 3, 322-33 (March, 1959).

The constant ratio of yields of successive even or odd mass number nuclides produced in the Mike fusion explosion of 1952 implies an approximate constancy of the corresponding neutron capture cross-sections for neutrons near 100 keV for the nuclei between U^{238} and U^{254}. A discussion is given of the physical quantities on which the neutron capture cross-sections depend, particularly radiation widths, nuclear level spacings, and neutron binding energies. It is concluded that conventional mass formulae are probably wrong in predicting a large decrease in neutron binding energy as one goes from U^{238} to U^{254}. It is possible that the addition of a direct symmetry term to the mass formula might repair this difficulty. Another possibility is that an extra diffuseness of the nuclear surface in neutron-rich nuclei would reduce the Coulomb energy of the nucleus, thus stabilizing neutron binding energies.

539.14

8514. DETERMINATION OF THE SPINS OF THE EXCITED LEVELS FOR NEUTRON CAPTURE BY TUNGSTEN 183.

Vinh-Dinh Huynh, J.Julien, C.Gorge, F.Netter and J.Sinue.

C.R. Acad. Sci. (Paris), Vol. 248, No. 16, 2330-2 (April 20, 1959).

In French.

From the analysis of the energy distribution and time-correlations of the γ emitted, the following values are obtained. J = 1 (7.62, 27.1, 40.8, 46.6 and 65.7 eV); J = 0 (48.1 eV).

J.Lascoux

539.14

8515. MEASUREMENT OF THE ENERGIES OF NUCLEAR STATES EXCITED BY INELASTIC NEUTRON SCATTERING, AND A SEARCH FOR ELECTRIC MONOPOLE TRANSITIONS IN Pb.

J.E.Evans, B.B.Kinsey and B.G.Whitmore.

Canad. J. Phys., Vol. 37, No. 4, 396-412 (April, 1959).

A method of measuring the energies of nuclear states excited by inelastic neutron scattering is described, in which an energy-selective detector is used. The neutron source was Li or H^3 bombarded by protons from a Van de Graaff generator. The ratio of the counting rate produced in this detector by the material under study to that produced by a long counter was plotted against the proton energy. Peaks in this curve occur when the energy of the scattered neutrons is equal to the resonance energy of the selective detector (255 keV). The energies of the excited states responsible for these neutrons were determined with some precision by a step-by-step comparison with those produced by a standard material for which the energies of the excited states are already well-known (e.g. Fe^{56}). A weak peak, not corresponding to any known state, was found in Zr. Two states in Fe^{56} were used to determine the energies of peaks obtained from Pb. One of these was that due to the well-known state at 2.62 MeV. However, peaks were observed corresponding to both lower and higher energies, none of which agree with those of known excited states. Except for that caused by the 803 keV state of Pb^{206}, no other peaks were observed from a target of Pb^{206}. Th^{232} produced strong peaks corresponding to excited states at 760 and 1080 keV; U^{238} produced a peak at 710 keV and another (unresolved from higher energy peaks) at 940 keV. Both peaks near 700 keV from these two nuclei showed unresolved structure. A peak was found from natural Pb corresponding to an excited state at 3.185 MeV. Reasons are given for believing that this state is 0^+. An unsuccessful search was made for annihilation radiation using coincident NaI crystals in a rectilinear arrangement. This apparatus detected readily the pair production from the 0^+ state in Zr^{90}, but was apparently responsible for a spurious effect in Pb. If pairs are emitted by a 3.185 MeV state in Pb^{208}, the cross-section for this process for neutrons with energy 0.5 MeV above threshold is probably less than one half of that from Zr^{90} for an equal energy excess above threshold.

539.14

8516. SPINS OF EXCITED STATES OF Os^{188}.

W.J.King and M.W.Johns.

Canad. J. Phys., Vol. 37, No. 6, 755-74 (June, 1959).

Seven excited states of Os^{188} populated through the beta decay of Re^{188} have been studied by gamma—gamma angular correlation experiments. The data for the various cascades fit the following theoretical functions: (all gamma-ray energies are in keV and the description following each cascade refers to the first transition) 478-155 (2-2-0, 99.7% E2, δ +ve), 931-155 (0-2-0), 672-633 (2-2-0), 97% M1, δ −ve or 3-2-0, 94% M1, δ −ve or conceivably 4-2-0), 828-633 (2-2-0, 98% M1, δ −ve or conceivably 3-2-0, 80% M1, δ −ve), 1132-633 (0-2-0), and 1308-633 (2-2-0, 98% M1, δ −ve). Some attenuation occurred in the correlations involving the 155 keV gamma ray. The K-conversion coefficients for the 478 and 633 keV transitions have been measured as 0.023 ± 0.003 and 0.010 ± 0.002 respectively, confirming the E2 character for these transitions obtained by angular correlation. These results, coupled with data concerning log ft values and gamma-ray intensities, lead to the following spin and parity assignments for levels in Os^{188}: 155 (2+), 633 (2+), 1086 (0+), 1306 (2+ or 3+), 1461 (2+), 1765 (0+), 1941 (2+), and 1958 (1+ or 2+). The 631-137 correlation data in Os^{186} was found to fit an attenuated 2-2-0 function with the first transition 99% E2 and δ −ve. This result supports the established decay scheme for this nucleus.

539.14

8517. A STATISTICAL ANALYSIS OF EXCITED NUCLEAR STATES. T.Ericson.

Nuclear Phys., Vol. 11, No. 3, 481-91 (June (1), 1959).

The many known excited states of some medium-weight nuclides are analysed in terms of the total number of states as a function of the excitation energy. Low-energy nuclear temperatures can be determined and are found to agree well with those obtained from evaporation spectra. There is a marked odd-even difference in the number of states of odd and even nuclei, appearing as a displacement of the curves with respect to each other by the pairing energy. Information on the spin distribution among the excited states is obtained and is related to a nuclear moment of inertia. The theoretical interpretation of the odd-even effect and a constant temperature is discussed in terms of an energy-gap model.

539.14 : 539.12

Li^7 STRUCTURE FROM PROTON—PROTON SCATTERING DATA. See Abstr. 8452

539.14

8518. ON THE STRUCTURE OF ROTATIONAL LEVELS OF ATOMIC NUCLEI. K.Wildermuth and T.Kanellopoulos.
Nuclear Phys., Vol. 9, No. 3, 449-75 (Jan. (1), 1959).

It is shown that two kinds of nuclear rotational levels exist. The first kind appears in light nuclei, but a clear rotational energy spectrum is only very seldom connected with this. The second kind appears rather regularly in heavy nuclei with large deformations. There are two other main differences between these two kinds of rotational levels. If in light nuclei a rotational energy spectrum is present, then this spectrum always breaks off abruptly, in contrast to the second kind of rotational spectrum. The second main difference is that the ratios of the γ-transition probabilities for the second kind of rotational levels can be described by the collective model. As opposed to this, the corresponding ratios of the first kind are reduced strongly compared with the values of the collective model. More general questions are briefly discussed.

539.14

8519. ON THE CONNECTION BETWEEN THE CLUSTER MODEL AND THE SU_3 COUPLING SCHEME FOR PARTICLES IN A HARMONIC OSCILLATOR POTENTIAL. B.F.Bayman and A.Bohr.
Nuclear Phys., Vol. 9, No. 4, 596-9 (Jan. (2), 1959).

It is shown that the cluster model of Wildermuth and Kanellopoulos (Abstr. 6205 of 1958; and preceding abstract) provides an alternative description of certain states in the SU_3 coupling scheme of Elliott (Abstr. 5264-5 of 1958).

539.14

8520. RELATIVE TRANSITION PROBABILITIES BETWEEN ROTATIONAL LEVELS OF NON-AXIAL NUCLEI.
A.S.Davydov and V.S.Rostovsky.
Nuclear Phys., Vol. 12, No. 1, 58-68 (June (3), 1959).

Energies and wave-functions are calculated for the rotational states ($J = 4, 6, 8$) of non-axial nuclei. Relative reduced E2 transition probabilities for the rotational band levels of such nuclei are derived. Conditions under which the rotational states can be characterized by quantum numbers K are established. It is shown that if the nuclear shape differs from axial symmetry, the 1 : 3.3 : 7 : 12 interval rule observed in rotational bands of axial nuclei is violated. The theory is compared with the experimental data.

539.14

8521. GAMMA RAYS FROM THE EXCITED STATES OF ^{16}O.
T.Wakatsuki, Y.Hirao, E.Okada and I.Miura.
J. Phys. Soc. Japan, Vol. 12, No. 11, 1178-85 (Nov., 1957).

By bombarding a fluorine target with 5.7 MeV protons, a new gamma radiation of energy 3.86 ± 0.02 MeV was observed with a three crystal pair spectrometer. This gamma radiation was proved to be emitted from the 10.98 MeV (or 10.77 MeV) state in O^{16} in the transition to 7.12 MeV (or 6.91 MeV) state by gamma—gamma coincidence experiments. No gamma radiation corresponding to the transitions from this state to other lower states in O^{16} was observed. 0^- (or $3+$) was assigned to this state. At 8.87 MeV gamma radiation corresponding to the direct transition to the ground state from the 2^- excited state in O^{16} was observed. A hard gamma radiation of about 11 MeV energy was found at proton energies between 4.8 and 5.7 MeV and was ascribed to the capture radiation in the $F^{19}(p\gamma)Ne^{20}$ reaction. A weak gamma radiation of about 4.9 MeV energy was also observed.

539.14

8522. RESONANCE SCATTERING OF GAMMA RAYS BY THE 4.46 MeV AND THE 5.03 MeV STATES OF B^{11}.
L.Cohen, R.A.Tobin and J.McElhinney.
Phys. Rev., Vol. 114, No. 2, 590-2 (April 15, 1959).

The continuous X-ray spectrum from the N.R.L. betatron was used to excite and study the 4.46 MeV and the 5.03 MeV states in B^{11}. The self-indication technique that was employed yielded the following values for the resonance integrals: $\sigma_0\Gamma = (0.79 \pm 0.21) \times 10^{-4}$ MeV barn for the lower state and $(0.98 \pm 0.17) \times 10^{-4}$ MeV barn for the upper state.

539.14

8523. DENSITY OF LOW-LYING PARTICLE LEVELS IN ODD-MASS NUCLEI IN THE REGIONS OF LARGE DEFORMATION.
F.H.Bakke.
Nuclear Phys., Vol. 9, No. 4, 670-8 (Jan. (2), 1959).

From experimental level schemes the mean densities of low-lying levels formed by excitation of single particles are found for nuclei with odd Z and odd N in the regions $A = 153$-185 and $A = 231$-245. These level densities are nearly twice as high as those for a Fermi gas of nucleons where the interaction is taken into account only by using a constant effective mass $m^* = 0.7$ m. Such an increase in the density of the low-lying levels will be caused by a residual interaction between the nucleons at the top of the Fermi distribution. This effect may also be interpreted in terms of a pairing interaction between the nucleons.

539.14

8524. E2—M1 MIXING RATIOS IN $2' \rightarrow 2 \rightarrow 0$ TRANSITIONS.
S.S.Malik, V.R.Potnis and C.E.Mandeville.
Nuclear Phys., Vol. 11, No. 4, 691-5 (June (2), 1959).

The results of twelve published angular correlation experiments have been analysed, and the E2—M1 mixing ratios of the $2' \rightarrow 2$ transitions have been obtained for twelve different even nuclei. Particular attention has been given to evaluation of the errors in the measured values of the mixing ratios. The available data range from $A = 56$ to $A = 198$. When $(\delta/E_\gamma)^2$ is plotted against $Z^2A^{\frac{4}{3}}$, three of the experimentally observed points, those for Fe^{56}, Zr^{92} and Hg^{198}, deviate sharply from a curve calculated from the theoretical considerations of Davydov and Filippov (Abstr. 1722 of 1959).

539.14 : 539.163.2

LEVEL SCHEME OF Ta^{181}. See Abstr. 7318

539.14 : 539.163.2

LEVEL SCHEMES OF $Au^{193,195,197}$. See Abstr. 7319

539.14 : 539.17

ELECTRON SCATTERING STUDIES ON Li^6. See Abstr. 7358

539.14 : 539.165

DE-EXCITATION OF Ir^{192} BY MEASURING THE β—γ DIRECTIONAL CORRELATION. See Abstr. 7323

539.14

8525. THE LIFETIMES OF EXCITED STATES OF GADOLINIUM 155. M.Vergnes.
C.R. Acad. Sci. (Paris), Vol. 248, No. 8, 1158-61 (Feb. 23, 1959).
In French.

Delayed β—γ coincidence measurements showed the half-lives of the states at 86.5 and 105.4 keV to be $(5 \pm 1) \times 10^{-9}$ and $\leq 1.2 \times 10^{-9}$ sec. The corresponding γ-rays have conversion coefficients of 0.4 ± 0.1 and < 0.75 which confirm these to be E 1 transitions.
M.A.Grace

539.14

8526. ENERGY AND ANGULAR DISTRIBUTIONS OF MESONIC HYPERFRAGMENT DECAYS. N.Byers and W.N.Cottingham.
Nuclear Phys., Vol. 11, No. 3, 554-68 (June (1), 1959).

The distribution in energy and angle for the decay $_\Lambda He^5 \rightarrow \pi^- + + p + He^4$ has been investigated. It is shown that the angular asymmetry observed in three-pronged hyperfragment decays of this type can result from low-energy nuclear resonances (compound nucleus formation). Angular and energy distributions for the decay $_\Lambda He^5 \rightarrow \pi^- + p + He^4$ are presented which have been calculated neglec ing pion interactions. The form of these curves is largely determined by the fact that there is a low-energy $P_{\frac{3}{2}}$ resonance in proton-He^4 scattering. Effects due to parity violation and pion interactions are discussed and it is found that they will not produce any significant qualitative effects.

RADIOACTIVITY

539.16.08

8527. SELF-ABSORPTION IN SOURCES PREPARED FOR 4π BETA COUNTING. J.S.Merritt, J.G.V.Taylor and P.J.Campion.
Canad. J. Chem., Vol. 37, No. 6, 1109-14 (June, 1959).

Using the $4\pi\beta$—γ coincidence method the self-absorption of $4\pi\beta$ counting sources prepared by a number of source preparation techniques has been measured for the negatron emitters Cs^{134} (86 keV branch only), Nb^{95}, Hg^{203}, Co^{60}, Sc^{46}, Rb^{86}, Au^{198}, Na^{24}, and the positr branch of Cu^{64}. The self-absorption varied from a few tenths of one per cent to about ten per cent for sources with a mean superficial density of 2 $\mu g/cm^2$ for most of the nuclides studied. Subsidiary experiments were carried out to indicate the variation of self-absorption with source superficial density.

539.163

8528. ON THE DECAY OF ^{67}Ge. R.A.Ricci and R.van Lieshout.
Nuclear Phys., Vol. 10, No. 4, 360-72 (April (1), 1959).

The beta and gamma spectra of Ge^{67}, decaying with a half-life of 18.7 ± 0.5 min, were studied with scintillation techniques. Three major positron groups were found, with observed endpoint energies of 3.14 (100^+), 2.30 (40^+) and 1.6 MeV ($<25^+$), each group probably being complex. A total of 18 gamma-rays were found in the decay and the coincidences between them were studied by the summing technique. A tentative decay scheme is proposed, which incorporates the levels in Ga^{67} known from other work.

539.163

8529. HALF-LIFE OF SULFUR-35. R.D.Cooper and E.S.Cotton.
Science, Vol. 129, 1360-1 (May 15, 1959).

A new determination was made of the half-life of the beta emitter sulphur-35. Approximately 400 measurements were taken over a period of a year and a half. These data were corrected for the dead time of the counter and then treated statistically. The half-life was found to be 86.35 ± 0.17 days.

539.163 : 539.1.07

8530. MEASUREMENT OF NUCLEAR ISOMERIC HALF-LIVES IN THE RANGE FROM ONE MICROSECOND TO TEN MILLISECONDS. I.E.Lindstrom and B.Crasemann.
Rev. sci. Instrum., Vol. 30, No. 5, 363-6 (May, 1959).

Relatively simple and accurate delayed coincidence apparatus for the measurement of isomeric half-lives in the millisecond range is described. Practical aspects of the statistics of delayed coincidence counting are discussed. Half-life measurements of Ta^{181m}(17.83 ± 0.10 μsec) and Y^{88m}(300.5 ± 5.0 μsec) are described.

539.163.1

8531. LIFETIME OF THE 186 keV LEVEL OF THORIUM-231. D.Strominger.
Phys. Rev., Vol. 114, No. 2, 502-4 (April 15, 1959).

Studied following U^{235} alpha decay. The half-life value of this level is 0.77 ± 0.12 mμsec.

539.163.2 : 539.14

8532. THE LEVEL STRUCTURE OF Dy^{160}.
R.G.Arns, R.E.Sund and M.L.Wiedenbeck.
Nuclear Phys., Vol. 11, No. 2, 411-18 (May (3), 1959).

Gamma-rays in Dy^{160} following beta decay of the 72 day Tb^{160} were studied using coincidence and angular correlation methods. The relative intensity and coincidence measurements confirm the principal features of the decay scheme proposed by Nathan (Abstr. 4272/1958). Angular correlation measurements were made on six cascades. The spin and parity of the 0.087, 0.964 and 1.262 MeV levels were found to be 2+, 2+, and 2− respectively. The measurements favour spins of 4 and 3 for the 0.283 and 1.359 MeV levels. These assignments are in agreement with previous assignments by Ofer (Abstr. 5277/1958). The multipolarities of the main gamma transitions are given.

539.163.2 : 539.14

8533. LEVELS IN Os^{190} POPULATED IN THE DECAY OF 11d Ir^{190}. O.B.Nielsen, N.O.R.Poulsen, R.K.Sheline and B.S.Jensen.
Nuclear Phys., Vol. 10, No. 4, 475-85 (April (1), 1959).

Eleven-day Ir^{190} was prepared in the Re$^{187}(\alpha, n)$Ir^{190} reaction. The decay scheme was investigated in a six-gap β-ray spectrometer. Numerous e—γ coincidence experiments were performed with the spectrometer in connection with a γ-ray scintillation spectrometer and a 100 channel kicksorter. Excited levels in Os^{190} at 186 (2+), 548 (4+), 557 (2+), 754, 956, 1161, and 1683 keV were established. It is shown that Os^{190} possesses nuclear properties which characterize the elements in the region between the group of spherical nuclei around A = 208 and the strongly deformed nuclei in the rare-earth group.

539.165

8534. A CONTRIBUTION TO THE SYSTEMATIZATION OF β-SPECTRA. R.Seidl.
Czech. J. Phys., Vol. 6, No. 6, 574-94 (Dec., 1956). In German.

The assumption is made that, in the case of β-decay, the energy change occurring in the nucleus system owing to the shift of the occupied terms when a nucleon jumps over to another term is negligible compared with the energy change caused by this jump itself. The author then systematically orders the properties of atomic nuclei and derives an energy scheme portraying mutual relationships which exist between the structures of various nuclei. The scheme enables the fundamental properties of unknown nuclei to be predicted from those of the structurally adjacent nuclei. Several conclusions drawn from the analysis are discussed. F.Lachman

539.165

8535. K-CAPTURE TO POSITON BRANCHING RATIOS IN THE DECAY OF Ga^{68}. M.K.Ramaswamy.
Nuclear Phys., Vol. 10, No. 3, 205-12 (March, 1959).

Measured using coincidence scintillation spectrometer techniques. The measured values are 1.28 ± 0.12 (to the first excited state) and 0.10 ± 0.02 (to the ground state). Assuming these decays to be pure Gamow—Teller transitions the Fierz interference terms are computed to be $b_{GT} = -0.03 \pm 0.02$ and +0.03 ± 0.01, respectively (the uncertainty in the latter result arising from uncertainty in N_0, the source strength). The ratio of positons to the first excited state and ground state of Sn^{68} was found to be $(1.76 \pm 0.22) \times 10^{-2}$. A search for a possible low-lying 0+ state in Ga^{68} was made through the decay of Ge^{68} using X-ray—X-ray and X-ray—γ-ray coincidences employing NaI(Tl) crystals. Besides the 9 KeV K X-ray, annihilation radiation and the known γ-ray in Ga^{68} whose energy was measured to be 1.067 ± 0.035 MeV, no other γ-ray was observed (<8% of 1.07 γ). The number of positons per 1.07 γ quantum was determined as 19.47 ± 2.10 by comparison with Na^{22}. An upper limit of 0.4% per decay was set on positon emission by Ge^{68}.

539.165

8536. SHAPE FACTORS FOR FIRST FORBIDDEN NON-UNIQUE BETA TRANSITIONS. A.H.Wapstra.
Nuclear Phys., Vol. 9, No. 3, 519-27 (Jan. (1), 1959).

New approximations are developed for the shape factors in non-unique beta decay. Simplifications are possible because the combination of the so-called forbidden beta-decay functions $(L_\nu M_\nu)^{1/2} \pm N_\nu$ (upper sign for negatons, lower sign for positons) is very small as compared to the functions themselves.

539.165

8537. INTERACTION MODES IN BETA DECAY. DECAY OF Na^{24}. N.A.Burgov and Yu.V.Terekhov.
Nuclear Phys., Vol. 10, No. 5, 541-51 (April (2), 1959).

Electron—neutrino correlation in the β-decay of Na^{24} was investigated. The method of observation is based on the effect of nuclear resonance scattering of the γ-rays of Mg^{24} accompanying the β-decay of Na^{24}. A gaseous source of Na^{24} was used. The most probable value of the correlation constant which is in agreement with the measurements proved equal to $\lambda = -(0.22 \pm 0.12)$. If one takes into consideration the isobaric spin and the experiments on the circular polarization of the γ-rays of Na^{24}, then it appears that the β-decay of Na^{24} is due only to interaction of the Gamow—Teller type. If follows then from the results of the present paper that only the axial vector mode of interaction, corresponding to $\lambda = -\frac{1}{3}$, should be effective in the β-decay of Na^{24}

539.165

8538. β—ν CORRELATION IN Ne^{23} WITH RESONANCE FLUORESCENCE.
N.E.Booth, G.W.Hutchinson, A.M.Segar, G.G.Shute and D.H.White.
Nuclear Phys., Vol. 11, No. 2, 341-8 (May (3), 1959).

The correlation between the β-rays and those γ-rays Doppler-shifted by nuclear recoil to the energy needed for resonance scattering, has been measured for Ne^{23}. This correlation is directly related to the β—ν correlation for Gamow-Teller negaton emission. The correlation expected depends on the M1, E2 mixing in the gamma transition. With the best estimate of this, the ratio of coincidences at 90° to those at 180° should be 0.87 for axial vector and 1.17 for tensor interaction. The experimental result, obtained in about 100 hours of running time, 0.56 ± 0.24, supports axial vector interaction. The results also give a value for the lifetime of the 436 keV level in Na^{23} of $(1.5 \pm 0.3) \times 10^{-10}$ sec.

539.165

8539. ELECTRON—NEUTRINO CORRELATION IN THE NEGATIVE DECAY OF Na^{24}. N.A.Burgov and Yu.V.Terekhov.
Zh. eksper. teor. Fiz., Vol. 34, No. 3, 769 (March, 1958). In Russian.
English translation in : Soviet Physics — JETP (New York), Vol. 34(7), No. 3, 529 (Sept., 1958).

Measurements are reported of the dependence of the cross-section for resonant scattering of γ-rays on the angle between the recorded γ quanta for Na^{24} vapour. E.J.Burge

539.165 : 539.14

8540. MESONIC "EXCHANGE" EFFECTS IN BETA-DECAY.

R.J.Blin-Stoyle, V.Gupta and H.Primakoff.
Nuclear Phys., Vol. 11, No. 2, 444-53 (May (3), 1959).

An estimate is made, using no-recoil meson theory, of the π-mesonic exchange contributions to the beta-decay of nuclei assuming that such effects only contribute to the axial vector part of the beta-decay interaction. A few per cent enhancement in the matrix element for the $H^3 \rightarrow He^3$ decay is obtained which is sufficient to account for the discrepancy between the decays of H^3 and n. A similar effect is found for heavier nuclei.

539.165

8541. THE BETA DECAY OF K^{40}.

W.H.Kelly, G.B.Beard and R.A.Peters.
Nuclear Phys., Vol. 11, No. 3, 492-8 (June (1), 1959).

Studied using a 1 in. diameter × 1 in. high KI(Tl) scintillation crystal. The Kurie plot of the beta spectrum was made linear down to less than 200 KeV by the use of the exact third forbidden correction factor. The uncertainty in the correction for electron escape is suggested as the main source of non-linearity below this energy. The extrapolated end point energy was 1.35 ± 0.02 MeV. A specific activity of 27.2 ± 0.5 betas per second per g of natural potassium was obtained. This corresponds to a decay constant $\lambda(\beta) = (4.72 \pm 0.09) \times 10^{-10} y^{-1}$ and a half-life $t(\beta) = (1.47 \pm 0.03) \times 10^9$ y.

539.165

8542. THE FIRST PARTIAL SPECTRUM OF THE Co^{60} β-DECAY.

F.Bonhoeffer.
Z. Phys., Vol. 154, No. 1, 62-9 (1959). In German.

This was measured using a scintillation spectrometer. The β-rays were detected by a split anthracene crystal containing the Co. The anthracene was surrounded by a large NaI crystal which was used to detect the γ-rays associated with the β-rays. Only those β-particles in coincidence with the sum line (2.50 MeV) of the γ-ray spectrum were counted. The counting equipment was calibrated against In^{114}. The maximum energy was found to be 318 ± 7 keV and the form of the spectrum above 10 keV was in good agreement with β-decay theory. D.H.Lord

539.165 : 539.1.07

USE OF β SPECTROMETERS WITH LINEARLY INCREASING MAGNETIC FIELD. See Abstr. 8431

539.165.08

8543. ABSOLUTE β-COUNTING IN A PROPORTIONAL FLOW-COUNTER. J.P.Roalsvig and R.N.H.Haslam.

Canad. J. Phys., Vol. 37, No. 4, 499-514 (April, 1959).

Self-absorption and backscattering of β-particles have been studied in a proportional flow-counter, and empirical formulae are obtained to correct for these factors in absolute β-counting. The correction factors will depend on the thickness of the sample, the atomic number of the backscattering material, and the maximum energy of the β-particles. Relationships between the mass-absorption coefficient and the maximum energy of the β-particles for the primary β-particles, and between the mass-absorption coefficient, the maximum energy of the β-particles, and the atomic number of the backscattering material for the backscattered β-particles, are obtained. The backscattering function is found to depend on the atomic number of the backscattering material alone.

539.166

8544. NUCLEAR SPECTROSCOPIC MEASUREMENTS ON MASS SEPARATED Pb^{198} SOURCES. B.Jung.

Nuclear Phys., Vol. 10, No. 4, 440-56 (April (1), 1959).

The conversion electron spectrum of Pb^{198} was studied in a double focusing β-spectrometer and the γ-spectrum in a single channel scintillation spectrometer. For electrons, the energy range 15-1500 keV was covered; and for gammas, the energy range 45-2.3 MeV. Mass separated sources were used throughout. When measuring the γ-spectrum, disturbances from the daughter activity Tl^{198} were diminished by employing a continuous chemical separation method. A tentative level scheme involving 8 excited levels and 20 transitions has been constructed.

539.166

8545. POLONIUM 210 AS A STANDARD OF γ RADIATION.

G.Bastin-Scoffier and R.J.Walen.
C.R. Acad. Sci. (Paris), Vol. 247, No. 25, 2333-5 (Dec. 22, 1958). In French.

The authors propose Po^{210} as a γ-ray standard, using the γ-rays from the first excited state of the Pb^{206} produced in α-decay. In order to find the γ intensity the γ/α ratio must be known. A measurement of the intensities of the two α-particle groups is reported. After correction for internal conversion this gives a γ/α ratio of $1.06 \times 10^{-5} \pm 2\%$. P.G.Murphy

539.166

8546. Co^{57} DECAY SCHEME. J.M.Ferguson.

Nuclear Phys., Vol. 10, No. 4, 405-11 (April (1), 1959).

The weak gamma radiations from Co^{57} were studied. In addition to the well-known 14, 123, and 137 keV gamma-rays, a 708 keV gamma-ray was observed, having an intensity of 2×10^{-3} gamma-rays per disintegration. No annihilation radiation was observed; an upper limit of 5×10^{-4} can be put on the number of positrons per disintegration. There was no evidence for any other gamma-rays. Although peaks appear in the pulse-height spectrum at 100 and 30 keV, they can be accounted for by scattering and X-ray escape effects in the scintillator.

539.166

8547. A $0^+ \rightarrow 0^+$ TRANSITION IN Ce^{140}.

B.S Dželepow, Yu.V.Kholnov and V.P.Prikhodtseva.
Nuclear Phys., Vol. 9, No. 4, 665-9 (Jan. (2), 1959).

A search has been made for gamma-quanta of energy ≅ 1900 keV in the spectrum of La^{140} by means of a gamma-spectrometer by analysis of recoil electrons. It is shown that if such exist, their intensity is $< 0.4 \times 10^{-3}$ quantum per disintegration. It is simultaneously confirmed that the spectrum of conversion electrons contains intense conversion lines corresponding to a transition energy of 1902 keV. The lower limit of the conversion coefficient of this transition proved equal to 0.38. Such a large value of this limit indicates that it is either a transition of high multipole order ($l > 10$), or a $0^+ \rightarrow 0^+$ transition in which gamma quanta of the given energy are entirely absent. The first assumption may be discarded, since in this case the lifetime of the 1900 keV state should be very great ($> 10^{10}$ years), whereas the intensity of the corresponding conversion line falls off with a half-life of ~ 40 hours. Thus one is dealing here with a new $0^+ \rightarrow 0^+$ transition. The characteristics of several other transitions in Ce^{140} are also discussed.

539.166

8548. ABSOLUTE DETERMINATIONS OF K-SHELL PHOTOELECTRIC CROSS-SECTIONS FOR URANIUM AT THE GAMMA-RAY ENERGIES 1173 AND 1332 keV.

S.Hultberg and R.Stockendal.
Ark. Fys., Vol. 15, Paper 28, 355-60 (1959).

The cross-sections were determined absolutely by beta-spectrometric comparison of conversion lines and photolines. The results are $\tau_{K,1173} = 7.2 \pm 0.5$ barns and $\tau_{K,1173} = 5.4 \pm 0.3$ barns. These values agree with τ_K as inferred from the tables of White (Abstr. 9229 of 1957) to within 5%. The present paper is a report of the first application of a new technique to the determination of τ_K. Advantages and limitations of the method are discussed.

539.166

8549. DIRECTIONAL CORRELATIONS OF GAMMA RAYS IN Te^{124}

T.Hayashi.
J. Phys. Soc. Japan, Vol. 13, No. 2, 117-25 (Feb., 1958).

The directional correlations of the 2.11-0.605 MeV and 1.71-0.605 MeV gamma-gamma cascades in Te^{124} were measured by using a newly designed coincidence spectrometer. Both of the correlation functions are compatible with the sequence 3 (D, Q) 2 (Q) 0, where quadrupole admixture in the first radiation is expected to be very small. The false coincidences occurring in this type of circuit are also described in some detail.

539.166

8550. MULTICHANNEL ANGULAR CORRELATION MEASUREMENT OF GAMMA RAYS FROM THE DISINTEGRATION OF Ag^{110m} AND SPIN ASSIGNMENT OF EXCITED LEVELS OF Cd^{110}.

M.Sakai, H.Ohmura and T.Momota.
J. Phys. Soc. Japan, Vol. 12, No. 9, 985-93 (Sept., 1957).

The angular correlation of the gamma-rays was studied with scintillation spectrometers. Ten correlation functions were measured by use of a twenty-channel pulse height analyser. The spin values of Cd^{110} in 2.93, 2.48, and 1.54 MeV excited states were found to be 3−, 2+ and 2± respectively and the radiation characteristic of three gamma-rays of energies 0.885, 0.935 and 1.390 MeV were also determined.

539.166 : 539.14

8551. ANGULAR CORRELATION MEASUREMENTS ON Cs^{133} AND THE MAGNETIC MOMENT OF THE 81 keV LEVEL.

E.Bodenstedt, H.J.Körner and E.Matthias.
Nuclear Phys., Vol. 11, No. 3, 584-98 (June (1), 1959).

The directional correlation of the 355 keV –81 keV γ–γ-cascade has been measured as

$$W(\theta) = 1 + (0.042 \pm 0.005)\ P_2(\cos\theta) - (0.004 \pm 0.007)\ P_4(\cos\theta).$$

The determination of the anisotropy as a function of the time delay between the two gamma-rays showed no measurable perturbations by internal fields. The directional correlation of the 276 keV – 160 keV γ–γ-cascade is found as

$$W(\theta) = 1 - (0.442 \pm 0.009)\ P_2(\cos\theta) - (0.040 \pm 0.012)\ P_4(\cos\theta).$$

The angular correlation data are in agreement with the proposed spin and parity assignments for the 81 keV level and the 436 keV level and yield $\frac{5}{2}+$ for the 160 keV level as the most probable value. A reinvestigation of the half life of the 81 keV level confirmed the known value. The result is $T_{1/2} = (6.31 \pm 0.05) \times 10^{-9}$ sec. Upper limits for the half-lives of the 160 keV level and the 436 keV level are $T_{1/2}(160\ \text{keV}) \leq 5 \times 10^{-10}$ sec and $T_{1/2}(436\ \text{keV}) \leq 1.5 \times 10^{-9}$ sec. The gyromagnetic ratio of the 81 keV level has been obtained by two different methods: (a) the rotation and attenuation of the directional correlation pattern of the 355 keV–81 keV γ–γ-cascade is observed in a constant external magnetic field; (b) the anisotropy of the same directional correlation is measured as a function of the external magnetic field. The result is $g = +1.23 \pm 0.12$, which yields a magnetic moment $\mu = 3.1 \pm 0.3$ nuclear magnetons. A lower limit for the gyromagnetic ratio of the 160 keV level can be given: $g \geq +0.25$. This result has been obtained by observing the rotation of the 276 keV–160 keV directional correlation in an external magnetic field of 24 200 G. This field yields a rotation $\omega_L \cdot \tau = +1.20^\circ \pm 0.35^\circ$ (ω_L = Larmor frequency, τ = mean life of the 160 keV level).

539.166

8552. GAMMA–GAMMA ANGULAR CORRELATIONS IN Tm^{169}.

S.Koički, J.Simić and A.Kukoč.
Nuclear Phys., Vol. 10, No. 4, 412-17 (April (1), 1959).

It was found that both K-forbidden transitions of 177 and 198 keV are mixtures of M1 and E2 multipoles. The magnitudes and the interference signs of these mixtures have been determined.

539.166

8553. SIGN OF THE NUCLEAR QUADRUPOLE INTERACTION BY OBSERVATION OF POLARIZED GAMMA–GAMMA ANGULAR CORRELATIONS.

S.M.Harris.
Nuclear Phys., Vol. 11, No. 2, 387-99 (May (3), 1959).

The sign of the nuclear quadrupole interaction cannot be determined by measurement of unpolarized γ–γ angular correlations. It can, however, be found by measuring the circular polarization of one of the radiations. Appropriate formulae are given to enable the reader to easily calculate the correlation function as a function of crystal orientation in the cases where the two radiations make angles of 90° and 180° with each other, are of multipole order $L \leq 2$, and involve an intermediate state with spin $I \leq \frac{7}{2}$. For the 90° case, in general, terms enter which are dependent on the sign of the interaction. The application of this technique to unpolarized β–γ correlations is also considered.

539.166

8554. INFLUENCE OF THE FINITE DIMENSIONS OF THE NUCLEUS ON THE RELATIVE CONVERSION COEFFICIENTS IN THE L-SUBSHELLS.

A.G.Sergeyev, V.D.Vorobyev, A.S.Remenny, T.I.Kolchinskaya, G.D.Latyshev and Yu.S.Yegorov.
Nuclear Phys., Vol. 9, No. 3, 498-508 (Jan. (1), 1959).

Measurements were made of the relative internal conversion coefficients in the L-subshells for three pure M1 transitions: 46.5 keV in Bi^{210}, and 115.1 and 238.6 keV in Bi^{212}. In it shown that in order to obtain agreement with the experimental data, it is necessary to take into consideration the finite dimensions of the nucleus in the theoretical calculations of the L internal conversion coefficients. Measurements were also made of $L_I : L_{II} : L_{III}$ for the 277.3 keV M1 transition in Pb^{208}.

539.166

8555. CONVERSION COEFFICIENTS OF GAMMA TRANSITIONS IN Tl^{203}.

G.J.Nijgh, A.H.Wapstra, L.T.M.Ornstein, N.Salomons-Grobben, J.R.Huizenga and O.Almen.
Nuclear Phys., Vol. 9, No. 3, 528-37 (Jan. (1), 1959).

The coefficients are determined as $\alpha_K = 0.163 \pm 0.003$, $\alpha_L = 0.0487 \pm 0.0012$ for the 279.12 keV gamma transition, and $\alpha_K = 0.118 \pm 0.011$ for the 404 keV transition. These results are discussed in view of possible deviations from theoretical values for M1 and E2 conversion coefficients. The decay energy of Pb^{203} is estimated to be 950^{+300}_{-70} keV.

539.166

8556. CONVERSION COEFFICIENTS OF GAMMA TRANSITIONS IN Hg^{198}.

A.H.Wapstra, G.J.Nijgh, N.Salomons-Grobben and L.T.M.Ornstein.
Nuclear Phys., Vol. 9, No. 3, 538-44 (Jan. (1), 1959).

The K and L conversion coefficients of the 412 keV E2 transition following the decay of Au^{198} are measured to be 0.0281 ± 0.0005 and 0.0097 ± 0.0004. Both values are about 10% lower than the theoretical values. The main beta spectrum of Au^{198} agrees with the theoretical shape for first forbidden non-unique spectra; its endpoint is 966 ± 3 keV.

539.166

8557. INTERNAL CONVERSION OF GAMMA-RAY TRANSITIONS IN As^{75}.

F.R.Metzger and W.B.Todd.
Nuclear Phys., Vol. 10, No. 3, 220-5 (March, 1959).

The internal K-conversion coefficients of the 136, 265, 280, 305, and 402 keV transitions were measured using a lens spectrometer and scintillation counters. The E1 character of the 136 and 402 keV transitions was confirmed, and the E3 assignment to the 305 keV gamma ray was clearly established. For the 265 and 280 keV E2 + M1 transitions, mixing parameters $\delta_{265} = -0.06 \pm 0.04$ and $\delta_{280} = -0.42 \pm 0.05$ were obtained on the basis of all the presently available information. The M1 transition probability of the 265 keV transition is at least one order of magnitude larger than that of the 280 keV transition while the E2 transition probabilities appear to be comparable. The spin and parity assignments made by Schardt (Abstr. 7311/1958) were confirmed.

539.166

8558. CONVERSION COEFFICIENTS FOR ELECTRIC QUADRUPOLE TRANSITIONS.

G.J.Nijgh and A.H.Wapstra.
Nuclear Phys., Vol. 9, No. 3, 545-50 (Jan. (1), 1959).

The measured K and L shell conversion coefficients of the 412 keV transition in Hg^{198} and the 279 keV transition in Tl^{203} are compared with the results of calculations by Rose and by Sliv and Band which are corrected for effects due to the finite nuclear size. The experimental results do not completely agree with the theoretical values, although neither E2 transition is delayed.

539.166

8559. MEASUREMENT OF HIGH-ENERGY GAMMA-RAYS WITH A PHOTOGRAPHIC BENT CRYSTAL SPECTROGRAPH.

E.L.Chupp, J.W.M.DuMond and H.Mark.
Rev. sci. Instrum., Vol. 29, No. 12, 1153-4 (Dec., 1958).

The Co^{60} 1.17 and 1.33 MeV γ-rays were observed by the use of a 2-meter bent crystal Cauchois spectrograph, employing an extended source on the convex side of the crystal and a 600-micron Ilford G-5 emulsion on the focal circle for recording purposes. A collimator protects the emulsion from the undiffracted beam. The line wavelengths can be determined with an accuracy of one part in 10^3. The advantages and disadvantages of the arrangement are discussed.

I.C.Demetsopoullos

539.166 : 539.1.07

Hg^{203}, Cs^{137} AND Co^{60} SPECTRA. See Abstr. 8434

539.166.07

8560. AUTOMATIC GAMMA-RAY SPECTROMETER.

M.Frank.
Nuovo Cimento, Vol. 12, No. 4, 385-88 (May 16, 1959). In Italian.

A single channel γ-ray spectrometer is described. The number of pulses counted on each channel is automatically recorded on a paper ribbon, and the apparatus is then ready for measuring the next channel.

NUCLEAR REACTIONS

539.17

8561. PERTURBATION THEORY IN NUCLEAR REACTIONS.

G.E.Brown, C.T.De Dominicis and J.S.Langer.
Ann. Phys. (New York), Vol. 16, No. 3, 209-20 (March, 1959).

Exact expressions for the amplitudes for scattering of a particle by a complex nucleus are written down. It is then shown that, with a particular weight function, the scattering amplitude can be averaged over energy by going to a complex energy, i.e. $[S(E)]_{Av} = S(E + iI)$, where I is the interval averaged over. The average amplitude is then expressed in terms of a perturbation expansion. In perturbation theory of the first kind, expansion in powers of the interaction potential between the incident particle and the particles in the nucleus is carried out. In the second kind of perturbation theory, all particles are treated symmetrically and all but the average effects of the interactions are treated as perturbations. This allows one to relate the parameters of the optical potential back to nucleon—nucleon forces. It is shown that these expansions are, in general, convergent, due to the fact that the excitation into which a given excitation decays has a longer lifetime than the original one.

539.17 : 539.12

8562. THRESHOLD BEHAVIOR OF CROSS SECTIONS OF CHARGED PARTICLES. L.Fonda and R.G.Newton.

Ann. phys. (New York), Vol. 7, No. 2, 133-45 (June, 1959).

The energy dependence of scattering and reaction cross-sections at the threshold of a new channel with Coulomb forces is investigated. In the case of opposite charges an anomaly is found in which the average over the Coulomb bound state resonances below the threshold energy is discontinuosly different from the limit from above. The resolution and precision necessary, however, make it very difficult to measure the phenomenon.

539.17

8563. TERTIARY AND GENERAL-ORDER COLLISIONS. L.M.Delves.

Nuclear Phys., Vol. 9, No. 3, 391-9 (Jan. (1), 1959).

The general formalism of scattering theory is extended to cover reactions in which more than two particles exist in the entrance or exit channels, and the behaviour of the scattering matrix in this general case is discussed at arbitrary energies, in particular near thresholds. The energy dependence of observable quantities such as cross-sections and polarizations is given, and the occurrence and origin of the Wigner cusps and their counterpart in the general case are clearly seen; such singularities do not arise from the behaviour of the eigenphase-shifts. Coulomb effects are not considered in the general case.

539.17 : 539.12

8564. ON THE ENERGY DEPENDENCE OF THE ANISOTROPY OF HIGH-ENERGY NUCLEAR INTERACTIONS. G.Bozóki and E.Gombosi.

Nuclear Phys., Vol. 9, No. 3, 400-11 (Jan. (1), 1959).

The energy dependence of the anisotropy parameter X defined for high-energy nuclear interactions has been determined in nucleon—nucleon and nucleon—nucleus collisions according to the Landau theory of meson production. An empirical formula

$$X = (0.82 {}^{+0.06}_{-0.07})\gamma_c^{(0.35 \pm 0.04)}$$

is given for the variation of the degree of anisotropy with γ_c, the Lorentz factor of the c.m.s. in the 10^{10}–10^{14} eV energy range. It is shown on the basis of available experimental data that contrary to expectation no correlation is to be found between the number of shower particles n_s and the anisotropy, if $\gamma_c > 10$ and $n_s > 4$. An evaluation of the data on the basis of the "excited nucleon" model of meson production is given.

539.17

8565. ON THE DIRECT NEUTRON EXCHANGE INTERACTION OF COMPLEX NUCLEI INVOLVING A POSSIBLE LARGE CHANGE OF THE NUCLEAR SPINS. V.I.Goldansky.

Nuclear Phys., Vol. 9, No. 3, 551-7 (Jan. (1), 1959).

It is shown that it may be possible to observe a process of direct interaction of complex nuclei in which these nuclei, being on the outer boundary of the Coulomb potential barrier, exchange neutrons. If the neutrons in the outer shells have large momenta, their exchange may result in a large change of the spins of the interacting nuclei and in the excitation of otherwise inaccessible levels, corresponding to all possible values of the nuclear spin and its projection for different arrangements of a given number of neutrons in the outer shell. The exponent characterizing the probability of the process under consideration is estimated according to a method proposed by Landau (1932) and applied to some other problems by E.M.Lifshits (1938, 1939).

539.17

8566. ON ANGULAR DISTRIBUTIONS IN COMPOUND NUCLEUS PROCESSES. (ADDENDUM). T.Ericson and V.Strutinsky.

Nuclear Phys., Vol. 9, No. 4, 689-90 (Jan. (2), 1959).

See Abstr. 1756 (1959).

539.17

8567. TIME-REVERSAL AND POLARIZED NUCLEAR REACTIONS. L.C.Biedenharn.

Nuclear Phys., Vol. 10, No. 5, 620-5 (April (2), 1959).

The generalized polarization-asymmetry theorem requires only reciprocity and not reversibility. The application of this result to complex potentials is discussed in detail.

539.17 : 539.14

8568. FOCUSING OF PARTICLES IN THE OPTICAL MODEL. I.E.McCarthy.

Nuclear Phys., Vol. 11, No. 3, 574-83 (June (1), 1959).

The behaviour of the quantal flux of neutrons in a typical optical model potential is examined as the energy is increased from 5 to 30 MeV. At the higher energies the behaviour can be described quite well by geometrical optics using the classical trajectories of the neutrons. The classical focus is reproduced quantally both in its general shape and its behaviour with varying energy and potentials. There are also standing wave effects near the far edge of the nucleus which cannot be understood classically. The relative probability of reactions occurring in different angular regions and in different radial regions is estimated by integrating the divergence of the flux over these regions.

539.17 : 539.14

DIRECT INTERACTIONS AND THE OPTICAL MODEL.

See Abstr. 8501

539.17

8569. THEORY OF RADIATIVE CAPTURE REACTIONS. A.M.Lane.

Nuclear Phys., Vol. 11, No. 4, 625-45 (June (2), 1959).

Starting from an exact dispersion theory, it is shown how cross-sections for capture by various mechanisms may be extracted by appropriate specializations of the theory. The cross-section for "compound nucleus" capture is derived by the usual assumption of random signs for matrix elements (reduced with amplitudes). It is pointed out that this cross-section reduces to the Weisskopf—Ewing formula that is commonly used only after a second assumption is made: that the density of energy levels of spin I in the final nucleus is proportional to (2I + 1). The cross-section for "direct" capture, which has previously been derived phenomenologically, is extracted from the exact formalism by techniques developed by Bloch and by Brown and de Dominics for treating other kinds of direct reactions. Attention is drawn to the fact that the integrals in the matrix elements of the electromagnetic interaction should be taken to infinity, thereby incorporating a contribution from the channels besides the usual one from the nuclear interior. In the following paper, this channel contribution is shown to be very important in practice.

539.17

8570. ANALYSIS OF EXPERIMENTAL DATA ON NUCLEON CAPTURE REACTIONS. A.M.Lane and J.E.Lynn.

Nuclear Phys., Vol. 11, No. 4, 641-9 (June (2), 1959).

Using expressions derived in the preceding abstract, estimates are made of capture cross-sections with emphasis on those for capture of 14 MeV neutrons by heavy elements. It is found that the compound nucleus mechanism for capture predicts values several orders of magnitude less than those observed, even after account is taken of the important "phonon cascade" contribution. The correct explanation of the data appears to be the "direct" mechanism, which gives order-of-magnitude agreement. Investigation of the structure of the direct E1 integrals shows that the contributions from inside the nucleus are dominated by those from outside. The same appears to be true of the direct component of photonuclear cross-sections.

539.17

8571. ON THE THEORY OF MULTIPLE SCATTERING. M.L.Ter-Mikayelian.

Nuclear Phys., Vol. 9, No. 4, 679-86 (Jan. (2), 1959).

A method for calculation of multiple scattering curves taking into account the finite dimensions of the nucleus is presented. Experimental results pertaining to scattering of fast electrons by nuclei are used in the calculations.

539.17 : 537.591.3

572. NUCLEAR INTERACTIONS IN NUCLEON—PROTON AND
UCLEON—CARBON NUCLEUS COLLISIONS ABOVE 10 GeV.
.Suga.
. Phys. Soc. Japan; Vol. 12, No. 11, 1171-7 (Nov., 1957).

Nuclear interactions in hydrogen and carbon by nucleons (a few
 several tens of GeV) were studied at mountain altitude using a
ultiplate cloud chamber which contained paraffin, carbon and lead.
he cross-section for nuclear interaction by nucleon—proton col-
sion was found to be 60 ± 17 mb, assuming the cross-section for
ucleon—carbon nucleus to be 320 mb. Energy spectra of neutral
ions produced in paraffin, graphite and lead were compared. The
nergy distribution of neutral pions in paraffin-interactions is
teeper in low energy regions and similar in high energy regions
ompared with that in carbon-interactions, and a possible inter-
retation is given. Charged secondary particles are emitted isotropi-
ally in the c.m. system in nucleon—nucleon collisions, and in the
arbon nucleus some secondary particles undergo secondary col-
sions in the same nucleus. The azimuthal angular distribution of
econdary particles was examined and the results are discussed.

539.17

573. ON THE POLARIZATION OF NUCLEONS IN HIGH
NERGY STRIPPING REACTIONS. A.G.Sitenko.
uclear Phys., Vol. 9, No. 3, 412-19 (Jan. (1), 1959).

Polarization of nucleons stripped from deuterons in encounters
ith nuclei is determined on the basis of the generalized diffraction
ethod in which account is taken of spin—orbit interaction.

539.17

574. SPALLATION OF THE SEPARATED ISOTOPES OF
OPPER BY 660 MeV PROTONS. I.A.Yutlandov.
ul. Inst. Politeh. Iasi, Vol. 3(VII) No. 3-4, 85-94 (1957). In
ussian.

The separation and purification of radioactive isotopes of
u, Ni, Co, Fe, Mn, Cr, Sc, Ca, K and P is described, and the
ross-sections for their production from ordinary copper and
rom the separated isotopes are tabulated. Some of the yields
re briefly discussed. W.O.Lock

539.17

575. ON THE FORMATION OF ASTATINE 210 AND 211 IN
HE SPALLATION OF THORIUM 232 BY 160 MeV PROTONS.
.Lefort, G.Simonoff and X.Tarrago.
.R. Acad. Sci. (Paris), Vol. 248, No. 2, 216-18 (Jan. 12, 1959).
 French.

Cross-sections for the production of At^{211} and At^{210} from
h^{232} by 160 MeV protons were found to be 0.21×10^{-3} and
$.8 \times 10^{-3}$ barns, respectively. Astatine was separated electro-
hemically. The isotopes were identified by their α-spectra,
easured in an ionization chamber. The cross-sections are too
rge to be explained on a simple theory. P.G.Murphy

539.17

576. ANALYSIS OF TWO INTERFERING 1/2+ LEVELS IN THE
ISINTEGRATION OF C^{14} BY PROTONS.
.J.Ferguson and H.E.Gove.
anad. J. Phys., Vol. 37, No. 5, 660-71 (May, 1959).

Two interfering resonances occurring at bombarding energies
 1.32 MeV and 1.51 MeV in the reactions $C^{14}(p,n)N^{14}$ and $C^{14}(p,\gamma)N^{15}$
ave been analysed in terms of Wigner's two-level formula. Res-
nant energies and reduced widths have been found which give good
ts to the shapes of the yield curves for both processes in the
eighbourhood of the resonances. The absolute cross-sections for
e $C^{14}(p,n)N^{14}$ and $N^{14}(n,p)C^{14}$ reactions are obtained from the analy-
is without reference to the measured cross-sections. The calcula-
d cross-sections are found to be about 40% lower than the meas-
red ones.

539.17 : 539.14

577. SPIN AND PARITY OF THE 760 keV RESONANCE LEVEL
 THE REACTION $Si^{30}(p,\gamma)P^{31}$ AND OF THE INTERMEDIATE
EVELS IN P^{31}. L.Simons.
uclear Phys., Vol. 10, No. 3, 215-19 (March, 1959).

Certain triple angular correlation functions are calculated and
mpared with the results of triple angular correlation measure-
ents for the reaction $Si^{30}(p, \gamma)P^{31}$. The following was obtained:
in $\frac{5}{2}$ and even parity for the 760 keV resonance level, spin $\frac{1}{2}^+$
r the 3.51 MeV level and $\frac{5}{2}^+$ for the 2.23 MeV level.

539.17

8578. RESONANCE ENERGIES AND HALF-WIDTHS FOR PROTON CAPTURE IN ALUMINIUM.
S.L.Andersen, H.Bö, T.Holtebekk, O.Lönsjö and R.Tangen.
Nuclear Phys., Vol. 9, No. 3, 509-18 (Jan. (1), 1959).

A description is given of the methods used to obtain precise values for the resonance energies and half-widths in proton capture reactions. A target chamber designed for this purpose is described. Proton capture in Al^{27} was investigated in the proton energy range from 500 to 1400 keV. For all known resonances, energy values are given. For some of the resonances, the true half-widths and, for the rest, upper half-width limits are given.

539.17

8579. A STUDY OF THE GIANT RESONANCE REGIONS OF Be^8 AND C^{12} THROUGH THE INVERSE REACTIONS $Li^7(p,\gamma)Be^8$ AND $B^{11}(p,\gamma)C^{12}$. D.S.Gemmell, A.H.Morton and E.W.Titterton.
Nuclear Phys., Vol. 10, No. 1, 33-44 (Feb.(1), 1959).

In a search for fine structure in the giant resonance of C^{12}, an experiment was carried out to determine the excitation function for the ground state gamma-rays of the reaction $B^{11}(p,\gamma)C^{12}$ for protons in the energy range 4 to 7.7 MeV. The measured cross-sections can be related to the $C^{12}(\gamma,p)B^{11}$ cross-sections through the principle of detailed balancing. The experiment locates the maximum of the $C^{12}(\gamma,p)$ giant resonance at 22.55 (±0.1) MeV but does not resolve individual levels. The cross-section curve, however, is not smooth, and two peaks at C^{12} excitations of 21.4 and 22.1 MeV are suggested. The maximum value of the $C^{12}(\gamma,p)$ cross-section is found to be (29±5) mb. The reaction $Li^7(p,\gamma)Be^8$ was also investigated over a similar range of proton energies. Transitions to the 2.9 MeV level of Be^8 are found to predominate over those to the ground state throughout the energy range. The experiment suggests that the reaction $Be^8(\gamma,p)Li^7$, if it could be observed, would have a cross-section maximum at 22 MeV.

539.17

8580. 515 keV AND 679 keV RESONANCES IN THE REACTION $Na^{23}(p,\gamma)Mg^{24}$. L.Simons.
Phys. Rev., Vol. 114, No. 2, 569-70 (April 15, 1959).

The 515 keV and 679 keV resonance levels have previously been assigned $J = 1^+$ and $J = 3^+$, respectively, the latter being formed by LS coupling. An alternative assignment is presented in this paper, according to which the 515 keV level has $J = 2^-$ formed by jj coupling with $j_p = \frac{1}{2}^-$ or $j_p = \frac{3}{2}^-$. $J = 3^+$ is confirmed for the 679 keV resonance level, assuming jj coupling with $j_p = \frac{3}{2}^+$.

539.17

8581. EVIDENCE FOR DIRECT INTERACTIONS AT LOW ENERGY. H.A.Lackner, G.F.Dell and H.J.Hausman.
Phys. Rev., Vol. 114, No. 2, 560-5 (April 15, 1959).

The angular distributions of protons corresponding to the first excited-state transition in the reaction $Mg^{24}(p,p')$-1.38 MeV- have been measured for bombarding energies between 5.0 and 6.2 MeV. The angular correlations between the gamma rays emitted from the first excited state of Mg^{24} and the inelastically scattered protons have been measured at two different bombarding energies and for three proton detection directions. The angular correlation data are fitted to curves of the form $A + B \sin^2[2(\theta - \theta_q)]$, where θ_q is the momentum transfer direction for the reaction. The angular correlation data are consistent with predictions of the direct-interaction theory.

539.17 : 539.14

8582. INVESTIGATION OF THE 16.1 MeV EXCITATION LEVEL OF C^{12}. L.Keszthelyi and I.Fodor.
Nuclear Phys., Vol. 10, No. 5, 564-70 (April (2), 1959).

The radiation width for the transition to the ground state of the 16.1 MeV excitation level of C^{12} was determined by measuring the resonant absorption of γ-rays. The level width was found to be 7.5 ± 1.9 eV. The square of the matrix element for E2 transition, expressed in Weisskopf units, is 2.17 ± 0.55.

539.17

8583. RADIATIVE CAPTURE OF PROTONS IN Be^9. J.J.Singh.
Phys. Rev., Vol. 114, No. 3, 871-3 (May 1, 1959).

Measurements were made at proton bombarding energies of 662 and 998 keV. Branching ratios for various levels in B^{10} are given.

539.17 : 539.14

8584. ENERGY LEVELS OF Sc^{45} AND Ca^{42}.
W.W.Buechner and M.Mazari.
Rev. Mexicana Fis., Vol. 7, No. 3-4, 117-28 (1958).

The spectra of the reactions $Sc^{45}(p,p')Sc^{45}$ and $Sc^{45}(p,\alpha)Ca^{42}$ were studied with a high-resolution magnetic spectrograph at angles of 50°, 90°, and 130° for incident protons of 6.52 MeV energy. A table of the excited states of the Sc^{45} nucleus is presented and the ground state Q-value for the $Sc^{45}(p,\alpha)Ca^{42}$ reaction is calculated to be Q = 2.341 ± 0.008 MeV. S.J.St-Lorant

539.17

8585. ENERGY DISTRIBUTIONS OF Li^8 FRAGMENTS EMITTED FROM C, Al, Cu, Ag, Au, AND U BOMBARDED BY 2.2 BeV PROTONS. S.Katcoff.
Phys. Rev., Vol. 114, No. 3, 905-11 (May 1, 1959).

Targets of C, Al, Cu, Ag, Au, and U were irradiated with 2.2 BeV protons at the Brookhaven Cosmotron. The secondary fragments were collected in nuclear emulsions placed at various angles to the beam. From a study of the numbers and lengths of the "hammer tracks", the energy distributions of the ejected Li^8 fragments were derived for each target element at two or more angles. Analysis of the results, and comparison with evaporation calculations for Cu, Ag, and Au targets indicated the following. (1) In general, the observed spectra show considerably more high-energy Li^8 fragments than the calculated spectra. (2) The higher the fragment energy, the greater the tendency for emission in a forward direction. (3) From Ag, Au, and U targets, Li^8 may be ejected partially by an evaporation mechanism, but some other process must also play an important role. (4) For C, Al, and Cu targets, evaporation of Li^8 fragments from residual nuclei does not seem to be operating to any appreciable extent. (5) The Li^8 spectrum from Cu is surprising in that it lies higher in energy by several MeV than the Li^8 spectrum from Ag. (6) The spectrum of Li^8 from U is very similar to that from Au; there is no evidence for emission of Li^8 fragments from excited fission products. (7) The cross-section is estimated to increase monotonically from roughly one millibarn for Al to roughly ten millibarns for U.

539.17

8586. TOTAL CROSS SECTIONS FOR 910 MeV PROTONS.
M.E.Law, G.W.Hutchinson and D.H.White.
Nuclear Phys., Vol. 9, No. 4, 600-14 (Jan. (2), 1959).

The total cross-sections for the interactions of 910 MeV protons with carbon, oxygen, deuterium and hydrogen have been measured. The values obtained are σ_T(carbon) = 362.0 ± 2.4 mb; σ_T(oxygen) = 469 ± 10 mb; σ_T(deuterium) = 79.1 ± 1.0 mb; σ_T(proton) = 46.1 ± 0.5 mb and σ_T("neutron") = 33.0 ± 0.9 mb, where the apostrophes indicate that the neutron was bound in the deuteron. When allowance is made for this, a corrected value of σ_T(neutron) = = 39.2 ± 3.1 mb is obtained.

539.17

8587. NUCLEAR CROSS SECTIONS FOR THE SCATTERING OF NEUTRONS AND PROTONS. R.Jastrow and I.Harris.
Nuclear Phys., Vol. 9, No. 3, 437-45 (Jan. (1), 1959).

Cross-sections and polarization effects are calculated for the scattering of neutrons and protons by Al, Fe and Pb. The calculations are based on an optical model with rounded profile and spin—orbit coupling, and are carried out in WKB approximation above 300 MeV and by exact computation of the phase shifts at lower energies. The nuclear radii determined from the high energy data are smaller than those reported in earlier studies of nuclear cross-sections, and are close to the radii determined by the analysis of electron scatterings at high energies. The radius obtained from the 300 MeV analysis also yields good results for the scattering of neutrons by Zr at 7 MeV. At all energies polarization data are found to be essential for the determination of the parameters of the model.

539.17

8588. ON THE TRIPLE ANGULAR CORRELATIONS IN (p,γ) REACTIONS. L.Simons.
Comment. phys.-math. (Helsinki), Vol. 23, No. 3, 13 pp. (1959).

Triple angular correlation functions are calculated and compared with the results of triple angular correlation measurements for the reactions $Na^{23}(p,\gamma)Mg^{24}$ and $Si^{30}(p,\gamma)P^{31}$. For the former reaction the 515 keV level has $J = 2^-$ and the 679 keV level $J = 3^+$ and for the latter reaction the 760 keV resonance level has spin $\frac{5}{2}^+$, the 3.51 MeV level $\frac{3}{2}^+$ (possibly $\frac{1}{2}^+$) and the 2.23 MeV level $\frac{5}{2}^+$.

539.17

8589. SCATTERING OF 9.5 MeV PROTONS BY NITROGEN.
A.Hossain and A.N.Kamal.
Indian J. Phys., Vol. 31, No. 11, 553-9 (Nov., 1957).

The nuclear emulsion technique was employed for the detection of scattered particles. Exposure was made in 1952 at the Birmingham cyclotron, but the plates were scanned at Dacca University. Levels in N^{14} nucleus were obtained at 2.36 ± 0.03, 3.39 ± 0.05, 4.91 ± 0.03, 5.15 ± 0.02, 5.49 ± 0.02, 5.77 ± 0.03, 6.05 ± 0.02, 6.20 ± 0.03, 6.48 ± 0.05, 6.75 ± 0.03 and 7.01 ± 0.05 MeV. The angular distribution of protons elastically scattered by N^{14} was obtained. An asymmetric angular distribution was obtained for protons inelastically scattered by N^{14}, leading to the formation of the 3.9 MeV level.

539.17

8590. ELASTIC SCATTERING OF 40 MeV PROTONS FROM ISOTOPES OF Fe, Ni, AND Cu. M.K.Brussel and J.H.Williams.
Phys. Rev., Vol. 114, No. 2, 525-33 (April 15, 1959).

Protons (39.8 MeV) were scattered from thin targets of Fe^{54}, Fe^{56}, Ni^{58}, Ni^{60}, and Cu^{65}. Absolute differential cross-sections obtained with a statistical accuracy of ≤ 3% have been determined for the elastically scattered protons. The range of the angular distributions, 7.5° to 110°, encompassed three minima and three maxima in the measured cross-sections. The energy resolution of the detection equipment, utilizing a NaI(Tl) crystal, was 1.2-2%. This enabled a separation to be made of elastic from nonelastic events. A detector telescope allowed angular resolutions of $\pm\frac{1}{8}^{\circ}$ to be used in determining the shape of the features in the angular distributions. The general variation of the cross-sections with the nuclear mass is noted. In addition, the data suggest that the nucleon shell closing about nucleon number 28 introduces fine structure differences in the shape and magnitude of features of the scattering pattern.

539.17

8591. INELASTIC SCATTERING FROM SEPARATED LUTECIUM ISOTOPES. B.Elbek, M.C.Olesen and O.Skilbreid.
Nuclear Phys., Vol. 10, No. 3, 294-305 (March, 1959).

Lutecium targets of high isotopic purity were prepared in an electromagnetic isotope separator. In order to obtain thin deposits of the target material on fragile backings a method was developed where the ions after the separation are strongly retarded by an electrical potential on the collector. Targets prepared in this way were used to study the Coulomb excitation of the rare odd isotope Lu^{176} and of the abundant isotope Lu^{175} by observation of inelastically scattered protons and deuterons in a magnetic spectrometer. The measured excitation energies and transition probabilities in Lu^{176} are in good agreement with the predictions of the rotational model if the ground state spin of this isotope is 7.

539.17

8592. INELASTIC SCATTERING OF HIGH ENERGY PROTONS BY B^{11} AND O^{16}. L.Egardt.
Nuclear Phys., Vol. 11, No. 2, 349-56 (May (3), 1959).

The differential cross-sections for the inelastic scattering to the 4.46 MeV level of B^{11} and to the 6.06 and 6.14 MeV levels of O^{16} are calculated in the extreme L—S coupling picture. The transition to the excited state is described by the free nucleon—nucleon scattering matrix. Only the absorption part of the optical potential is taken into account. Good agreement with experiment is obtained.

539.17

8593. POLARIZATION OF HIGH ENERGY PROTONS IN ELASTIC AND INELASTIC SCATTERING.
A.Johansson, G.Tibell and P.Hillman.
Nuclear Phys., Vol. 11, No. 3, 540-53 (June (1), 1959).

The polarizations of 180 MeV protons elastically and inelastically scattered by lithium, beryllium, boron, iron and bismuth have been measured with an energy resolution of 2-2.5 MeV full width at half height. The polarizations of scattered protons corresponding to the low-lying levels closely resemble each other and previous results for carbon, oxygen and calcium. Good agreement is found when the data are compared with existing theoretical calculations. The elastic polarizations agree fairly well with measured asymmetries at those points where a comparison can be made.

539.17 : 539.1

8594. A NOTE ON THE INELASTIC SCATTERING OF HIGH ENERGY PROTONS BY LIGHT NUCLEI. L.Egardt.
Nuclear Phys., Vol. 12, No. 1, 84-6 (June (3), 1959).

The polarization for the inelastic scattering of 180 MeV proton by B^{11} is calculated using shell-model wave-functions in the L—S coupling extreme. Some discussion is given of the first 0^+-states in C^{12} and O^{16}.

539.17

8595. REACTION MECHANISM IN INELASTIC SCATTERING OF PROTONS FROM Mg, Cr, AND OTHER ELEMENTS FROM 3.5 TO 7 MeV. F.D.Seward.

Phys. Rev., Vol. 114, No. 2, 514-25 (April 15, 1959).

Inelastic scattering of protons leading to the first excited states of Mg^{24} and Cr^{52} and to single excited states of other elements has been studied. At 90^0, $d\sigma/d\omega$ was measured as a function of proton energy from 3.5 to 7 MeV. Angular distributions of inelastically scattered protons and $p'-\gamma$ angular correlations were taken at several energies. Experimental measurements are compared with direct-interaction theory and with predictions of the statistical model. Data for $Cr^{52}(p,p')Cr^{52*}$ at 5.4 MeV is well fit by the statistical model. The $Mg^{24}(p,p')Mg^{24*}$ reaction at 7 MeV can be interpreted as a direct interaction. The Mg reaction at 5.4 MeV and the Cr reaction at 7 MeV appear to have a bit of direct interaction in them. It is suggested that the amount of direct interaction in this (p,p') reaction depends on the nuclear barrier height. Statistical-model expressions for reactions studied are given.

539.17

8596. INELASTIC SCATTERING OF HIGH ENERGY NUCLEONS BY COMPLEX NUCLEI. II. EXCITATION OF THE 4.4 MeV LEVEL OF ^{12}C. G.P.McCauley.

Proc. Phys. Soc., Vol. 73, Pt 2, 309-14 (Feb., 1959).

The formalism of a previous paper (Abstr. 4326 of 1958) is used to take into account both the real and imaginary parts of the optical potential and also the spin—orbit potential. The results obtained do not differ greatly from those obtained using only an absorptive potential, and indicate the need of a collective admixture to the pure LS shell model wave-function for the excited state.

G.P.McCauley

539.17

8597. TRITIUM PRODUCTION BY 6 BeV PROTONS. L.A.Currie.

Phys. Rev., Vol. 114, No. 3, 878-80 (May 1, 1959).

Tritium-formation cross-sections for 6 BeV protons on various targets between C and Pb are reported. No significant variations in tritium-production cross-sections are observed between 2 BeV and 6 BeV. The problem of tritium production in nature is discussed briefly.

539.17

8598. DEUTERON-PICKUP REACTION IN AN OPTICAL-MODEL APPROXIMATION. K.R.Greider.

Phys. Rev., Vol. 114, No. 3, 786-94 (May 1, 1959).

A theory of the (p,d) pickup reaction is described in which the nuclear interactions of the incoming and outgoing particles are considered. Two different formal expressions that give the transition amplitude are derived, and the wave-functions in this amplitude are approximated by an optical-model procedure in which it is assumed that the initial- and final-state particles scatter elastically in the nucleus. Several closed forms for these optical-model wave-functions are derived on the basis of a W.K.B. approximation for a complex square-well scattering potential. The use of these wave-functions, along with an approximation that gives the form of the transition amplitude in terms of Gaussian functions, allows a closed-form solution for the differential cross-section. It is found that the elastic-scattering processes are not negligible, since they affect considerably the magnitude and the shape of the differential cross-section. By comparing the theory with recent pickup experiments on C^{12} at 95 and 145 MeV, one obtains a nuclear-momentum distribution that, unlike the Born approximation analysis, is in good agreement with the results of other determinations of momentum distributions. It is found that a neutron number of from 4 to 6 neutrons and a momentum distribution of $\exp(-E/14)$ are required to fit the data.

539.17 : 539.12

TOTAL NEUTRON YIELDS FROM LIGHT ELEMENTS UNDER PROTON AND ALPHA BOMBARDMENT. See Abstr. 8466

539.17

8599. POLARIZATION OF NEUTRONS PRODUCED IN THE D—D REACTION. P.P.Kane.

Nuclear Phys., Vol. 10, No. 4, 429-39 (April (1), 1959).

Polarization of neutrons from the d(d, n)He reaction was measured at an average deuteron energy of 93 keV and emission angles of 43^0 and 53^0 in the laboratory system. The values of P_n are found to be $-10.6\% \pm 2.3\%$ and $-9.5\% \pm 3.7\%$, respectively. These are in excellent agreement with previous results at higher energies. The results of all experiments suggest that the polarization is independent of deuteron bombarding energy between 93 and 700 keV.

539.17

8600. THE INVESTIGATION OF THE MECHANISM OF THE $Cr^{52}(d,p)Cr^{53}$ REACTION. I.Šlaus.

Nuclear Phys., Vol. 10, No. 4, 457-67 (April (1), 1959).

The reaction was investigated at deuteron energies in the range from 3.29 to 4.4 MeV. The measurements reveal the importance of the direct interaction process. The small angle part of the angular distribution could be fitted to Butler's $L_n = 1$ curves. However, important deviations from the simple Butler theory have been found, which seem to be caused by the interference between stripping and compound nucleus formation. A pronounced secondary maximum evolved around 65^0, and possible explanations of it are discussed.

539.17

8601. GROSS STRUCTURE IN (d,p) REACTIONS NEAR Z = 50. R.A.Peck, Jr and J.Lowe.

Phys. Rev., Vol. 114, No. 3, 847-57 (May 1, 1959).

Proton spectra from $Sn^{120}(d,p)Sn^{121}$ and $In^{115}(d,p)In^{116}$ at 19.7 MeV are presented, covering 6.5 MeV of excitation in the product nucleus and laboratory angles from 15^0 to 155^0 at 10^0 intervals. The reactions are closely similar in all characteristics. Broad energy groups are discussed relative to the correlation with neutron single-particle states anticipated by a giant-resonance interpretation of their nature. Of four such groups identified, the spectral locations of three agree quantitatively with the single-particle level scheme deduced from binding-energy data. A group at 0.8 MeV, while consistent with single-particle gross structure, may represent a distinct nuclear level enhanced for reasons not clear. Angular distributions for the several groups fail to show the strong minima characteristic of pure stripping forms, probably as a consequence of the spreading of single-particle levels resulting from finite nuclear distortion which also weakens the spectral gross structure. However, the slight structure which the distributions do display is qualitatively consistent with stripping peak positions consequent on the single-particle interpretation of the spectra.

539.17

8602. THE $^{39}K(d,p)^{40}K$ REACTION.

A.W.Dalton, G.Parry and H.D.Scott.

Proc. Phys. Soc., Vol. 73, Pt 4, 677-81 (April, 1959).

Groups of protons corresponding to states in K^{40} up to an excitation energy of 5.34 MeV have been identified and the angular distribution of many of the groups determined. The nuclear radius was regarded as a variable parameter in fitting Butler stripping curves to these angular distributions and the values of l_n and the reduced width are given.

A.E.I. Research Laboratory

539.17

8603. THE REACTION $Mg^{24}(d,p)Mg^{25}$ AT E_d = 1.082 MeV.

H.Risti and T.Grotdal.

Univ. Bergen Arbok, 1958, No. 14, 8 pp.

Energies and angular distributions were measured of some of the proton groups emitted from a 35 $\mu g/cm^2$ Mg^{24} target bombarded with 1.082 MeV deuterons. The proton angular distributions were compared, where possible, with those calculated from the stripping theories, enabling assignments of spins and parities to be made to the levels of the residual nucleus. A spin and parity assignment of 3/2 or 5/2, even parity, has been made for the 3.899 MeV level in Mg^{25}. The relative yield of the different groups has also been found.

539.17

8604. RADIATIVE DEUTERON CAPTURE $Zn^{64}(d,\gamma)Ga^{66}$.

J.H.Carver and G.A.Jones.

Nuclear Phys., Vol. 11, No. 2, 400-10 (May (3), 1959).

Induced radioactivity methods have been used to observed radiative deuteron capture in Zn^{64} for deuteron energies of 3.5-4.5 MeV. Observations were made with NaI(Tl) gamma-ray spectrometers used singly and in coincidence and the 9.5 hour Ga^{66} activity was identified in the presence of an intense 245 day Zn^{65} activity resulting from the $Zn^{64}(d,p)$ and (d,n) reactions. At a deuteron energy of 4.5 MeV, $\sigma(d,\gamma) = 80 \pm 12\ \mu b$ and $\sigma(d,n+d,p) = 0.16 \pm \pm 0.02$ b. The cross-section ratio, $\sigma(d,\gamma)/\sigma(d,n+d,p) = 0.50 \pm 0.08 \times \times 10^{-3}$, is constant for 3.5-4.5 MeV deuterons. The magnitudes of the cross-sections and their variation with energy are consistent with an interpretation in terms of the statistical decay of a compound nucleus, the radiative probability being calculated from photodisintegration data.

539.17

8605. $Si^{28}(d,\alpha)Al^{26}$ REACTION. C.P.Browne.

Phys. Rev., Vol. 114, No. 3, 807-14 (May 1, 1959).

Earlier work on this reaction was extended and improved. The ground state Q-value of the reaction was remeasured and found to be 1.428 ± 0.004 MeV. Levels were found with excitation energies of (in MeV) 0.229 ± 0.003, 0.418 ± 0.002, 1.060 ± 0.002, 1.762 ± 0.003, 1.853 ± 0.003, 2.073 ± 0.003, 2.368 ± 0.003, 2.548 ± 0.004, 2.663 ± ± 0.004, 2.741 ± 0.005, 2.916 ± 0.006, 3.075 ± 0.006, 3.160 ± 0.006, 3.407 ± 0.006, 3.510 ± 0.010, and 3.596 ± 0.010. Seven of these have not been reported previously. The yields of the reaction leading to the ground state, the first excited state, and the second excited state were measured as a function of bombarding energy in the range 5.5 MeV to 7.5 MeV. There is strong resonance structure. The angular distributions for the reaction leading to these three states were obtained at 7.03 MeV bombarding energy. At this energy the total yield of the isotopic-spin forbidden reaction leading to the first excited state is 10% of the yield to the ground state. This violation of the selection rule can be explained by Coulomb force effects. The second T = 1 level could not be observed and the previous suggestion that the level at 3.16 MeV is the third T = 1 level seems to be incorrect. A comparison of the data with the results of other experiments is made. Energy levels of Al^{27} seen in the $Se^{29}(d,\alpha)Al^{27}$ reaction are listed and compared with results from $Al^{27}(p,p')Al^{27*}$. A new level at 5.745 ± 0.012 MeV was found plus several levels above the range of excitation previously covered.

539.17

8606. STUDY OF (d,α) REACTIONS ON SOME LIGHT NUCLEI.

G.E.Fischer and V.K.Fischer.

Phys. Rev., Vol. 114, No. 2, 533-9 (April 15, 1959).

The angular distributions of the charged particles from the $N^{14}(d,d)N^{14}$, $N^{14}(d,\alpha_0)C^{12}$, $N^{14}(d,\alpha_1)C^{12*}$, and $N^{15}(d,\alpha_0)C^{13}$ reactions have been studied with a deuteron bombarding energy of 21 MeV. The charged-particle groups are identified and their energy is measured by a dE/dX versus E counter telescope. The $N(d,\alpha)C$ angular distributions and the $O^{16}(d,\alpha)N^{14}$ angular distribution measured by Freemantle et al. have been compared with theoretical curves calculated from a simplified direct-interaction model. The relative magnitudes of the experimentally determined cross-sections have also been compared with theory. The results indicate that the $O^{16}(d,\alpha_0)$ reaction can be described by the compound-nucleus extreme, while the $N^{14}(d,\alpha_1)$ process appears to favour description by a direct-interaction model. The remaining (d,α) reactions are intermediate cases.

539.17

8607. INELASTIC SCATTERING OF 21.6 MeV DEUTERONS.

J.L.Yntema and B.Zeidman.

Phys. Rev., Vol. 114, No. 3, 815-20 (May 1, 1959).

The inelastic scattering of 21.6 MeV deuterons by Ni, Cu, Zn, Rh, Ag, Sn, Gd, Ta, Pt, and Au has been measured. A NaI(Tl) crystal sandwich was used for the detection of the scattered particles. The calculated energy scale of the spectrum was checked by observing the inelastic spectrum from Mg. The angular distribution shows a pronounced peaking in the forward direction. At background angles there is no increase in cross-section with increasing excitation, showing that compound-nucleus processes do not contribute to the cross-section. Up to an excitation of 10 MeV, the inelastic scattering cross-section for 21.6 MeV deuterons scattered at 60° by Au is not measurably different from that for 22 MeV protons. However, the inelastic deuteron cross-sections for Ni, Cu, and Zn are about half of the corresponding 22 MeV proton cross-sections at 60°. The gross structure found by Cohen in the inelastic spectrum is also observed in the present experiment. However, the gross structure in Ta and Gd appears to be considerably more pronounced in the deuteron spectrum than in the proton spectrum.

539.17

8608. ELASTIC SCATTERING OF 21.6 MeV DEUTERONS BY SEPARATED ISOTOPES OF NICKEL AND COPPER. J.L.Yntema.

Phys. Rev., Vol. 114, No. 3, 820-2 (May 1, 1959).

The relative differential cross-sections for the elastic scattering of 21.6 MeV deuterons by Ni^{58}, Ni^{60}, Cu^{63}, and Cu^{65} have been measured. The diffraction pattern shows a shift with atomic number. The shift from Ni^{58} to Ni^{60} is about the same as the one between Cu^{63} and Cu^{65}. The shift between Ni^{63} and Cu^{63} is about 1.5 times that of the others.

539.17

8609. THE $^{24}Mg(^3He, \alpha)^{23}Mg$ REACTION.

F. de S.Barros, P.D.Forsyth, A.A.Jaffe and I.J.Taylor.

Proc. Phys. Soc., Vol. 73, Pt 3, 513-15 (March, 1959).

Thin targets of Mg were bombarded by 5.23 MeV He^3 ions and the resulting particles analysed at 10°, 40° and 90° by means of a 90° broad-range magnetic spectrograph. Alpha groups were identified corresponding to the ground state of Mg^{23} together with 3 excited states, at 499 ± 5, 2 038 ± 8 and 2 350 ± 8 keV. These lie within about 2% of the known levels of the mirror nucleus Na^{23}. Results are consistent with spin and parity of 5/2+ for the first excited state of Mg^{23}.

J.H.Fremlin

539.17 : 539.14

8610. FLUX OF PARTICLES IN THE OPTICAL MODEL.

I.E.McCarthy.

Nuclear Phys., Vol. 10, No. 5, 583-9 (April (2), 1959).

The flux of 18 MeV α-particles in argon is calculated with two optical model potentials which give similar elastic scattering and reaction cross-sections. Although these potentials are similar in the nuclear surface, they give different fluxes inside the potential and in particular different values for the divergence of the flux which represents the probability of absorption of the beam at a point The divergence for α-particles in both potentials is peaked more strongly at the surface than that for protons of the same momentum in a realistic potential, but it is not negligible in the centre. The divergence peaks are of different heights in the two potentials and hence may give different total cross-sections for direct interactions

539.17

8611. THE α,α INTERACTION. E.van der Spuy.

Nuclear Phys., Vol. 11, No. 3, 615-24 (June (1), 1959).

The 8-body problem of the (α,α) scattering interaction is formulated using the group resonance formalism, with two unpolarized α-groups, and with the central nucleon—nucleon exchange force and α wave-function both having a Gaussian radial dependence. Choosing parameters as far as possible the same as required by the low energy nucleon—nucleon data, the α binding energy, and the (α,n) scattering interaction, it was attempted to explain the S- and D-phases for low energy (α,α) scattering which was previously found to require a velocity-dependent interaction. The (α,α) scattering requires slightly different values of y = 4w + 2b − 2h − m, both of which are lower than required by the (α,n) problem. It is shown that the S wave interaction essentially behaves as a potential at low energies. For low energies this potential effectively has a repulsive core with an attractive outside well — features which also emerged from a previous purely phenomenological analysis.

539.17

8612. ANGULAR DISTRIBUTIONS FOR ELASTIC AND INELASTIC SCATTERING OF 40 MeV ALPHA PARTICLES BY CARBON, NITROGEN, OXYGEN, AND ARGON. A.I.Yavin and G.W.Farwell.

Nuclear Phys., Vol. 12, No. 1, 1-34 (June (3), 1959).

Angular distributions for elastic and inelastic scattering of 40 MeV alpha particles by carbon, nitrogen, oxygen, and argon were obtained. Gas targets were used. Angles of observation ranged from 7° to 130° (laboratory) for carbon and over lesser intervals for the other elements. Elastic scattering angular distributions are characterized by sharply defined diffraction-like structure at the forward angles with maxima and minima spaced very regularly in $\sin \frac{1}{2}\theta$ (c.m.), deep minima near 90° (c.m.), and appreciable cross-sections at angles beyond 90°. A black nucleon diffraction interpretation gives reasonable absolute cross-sections for the forward maxima and good agreement with observed locations of maxima and minima. Inelastic scattering angular distributions were obtained fo C^{12}(Q = −4.43, −7.65 and −9.61 MeV); for O^{16} [Q = −6.06 and −6.14 MeV (unresolved), −6.91 and −7.12 MeV (unresolved)]; and A^{40} (Q = −1.462 MeV). Direct interaction analysis verifies previously assigned spins and parities and indicates an assignment of 0^+ or 2^+ to the 9.61 MeV level of C^{12}. Integrated cross-sections for inelastic scattering to individual levels may be as high as 6 per cent of πR^2. Interaction radii determined from diffraction analysis of the elastic scattering data are (in units of 10^{-13} cm) 5.11 ± 0.20 for C^{12}, 5.37 ± 0.17 for N^{14}, 5.64 ± 0.29 for O^{16}, and 6.38 ± 0.32 for A^{40} Interaction radii calculated from inelastic scattering data are consistently larger. Compound nucleus contributions to observed cross-sections appear to be small or zero.

539.17 : 539.12

613. SPECTRUM OF THIN TARGET BREMSSTRAHLUNG OUNDED BY A FORWARD CIRCULAR CONE.

J.H.Hubbell.

. appl. Phys., Vol. 30, No. 7, 981-4 (July, 1959).

The Schiff expression (Abstr. 7020 of 1951) for the cross-section er nucleus, for thin-target bremsstrahlung into the angular and nergy ranges $d\theta_0$ and dk, is integrated analytically over angle from ero to $\overline{\theta}_0$. Results are shown for the case $Z = 78$, $E_0 - mc^2 = 40$ MeV nd $\overline{x} = 0.5$, 1, 2, 4 and 8, where $E_0 - mc^2$ is the kinetic energy of e incoming electron and x is the reduced angle $\overline{\theta}_0 E_0/mc^2$. The raction of the total cross-section included in a cone of angle $\overline{\theta}_0$ can e approximated to within 20% by $x^2/(1 + x^2)$. At $x = 1$, or $\overline{\theta}_0 = 0.723^\circ$, e ratio of energy delivered by photons above $(E_0 - mc^2)/2$ to that elow is 9% greater than for the limiting spectral shape at $\overline{\theta}_0 = 0$, r that given by the Schiff expression at $\theta_0 = 0$, and 13% greater an for the spectrum integrated over all angles. For a target of nite thickness, multiple electron scattering should partially suppress the spectral dependence on $\overline{x}$.

539.17

614. NUCLEAR SCATTERING OF HIGH ENERGY ELECTRONS.

.Predazzi.

uovo Cimento, Vol. 12, No. 2, 177-80 (April 16, 1959).

An approximate method of calculating the phase-shifts, based n the W.K.B. method, is described and the results compared with xact calculations for 236 MeV electrons. C.J.Batty

539.17

615. POLARIZATION EFFECTS IN MOTT SCATTERING.

.Schopper.

uclear Phys., Vol. 11, No. 4, 675-86 (June (2), 1959). In German.

A complete verification of the theory for electron scattering by uclei can only be performed if at least three quantities are oberved: the differential scattering cross-section, the electron olarization perpendicular to the scattering plane and the change f an initial polarization in the scattering plane. Only the first two xperiments have been performed up to the present time. However, n the light of the parity experiments it seems now feasible to oberve at the same time the polarization before and after the scatterng. The effects to be expected were calculated for unscreened uclei. In contrast to the well-known polarization effects perpenicular to the scattering plane, there is only a small Z-dependence or the change of polarization in the scattering plane. Thus polariation effects can be investigated also for low values of Z. Experinental arrangements are proposed.

539.17

616. THEORY OF INELASTIC SCATTERING OF ELECTRONS N METALS. I.

A.Ya.Vyatskin.

h. tekh. Fiz., Vol. 28, No. 10, 2217-27 (1958). In Russian.

A theoretical analysis of the problem of inelastic scattering of lectrons of higher non-relativistic energies resulting from their nteraction with the lattice electrons. The solution obtained by onsecutive application of one-electron approximation of weak oupling for the lattice electrons confirmed the conclusions reached y the author in his earlier work (Abstr. 8791 of 1950).

M.H.Sloboda

539.17

617. THE THEORY OF THE INELASTIC SCATTERING OF LECTRONS IN METALS. II.

A.Ya.Vyatskin.

h. tekh. Fiz., Vol. 28, No. 11, 2455-68 (1958). In Russian.

The magnitudes and angular dependences of the characteristic osses of non-relativistic electrons falling on a metal are disussed, using the results of a previous paper (see preceding bstract) the losses being due to mutual Coulombic interactions ith the metallic electrons. The results are compared with the xperimental data for a large number of metals. The author also iscusses the further data needed to decide between his onelectron type theory and the Bohm—Pines theory (involving plasma scillations and the collective interaction of electrons).

K.F.Hulme

539.17

618. (γ,p) AND (γ,np) REACTIONS IN A^{40}.

.Brix, A.Körding and K.H.Lindenberger.

. Phys., Vol. 154, No. 5, 569-73 (1959). In German.

Argon gas was irradiated with 34 MeV bremsstrahlung. The elds of the reactions $A^{40}(\gamma,p)Cl^{39}$ and $A^{40}(\gamma,np)Cl^{38}$ were determined lative to $C^{12}(\gamma,n)$ by β-counting. The resulting upper limits for e cross-sections integrated to 28 MeV are 160 MeV mb for ,p) and 35 MeV mb for (γ,np). This does not confirm the anomausly high A (γ,p) cross-section reported in the literature.

539.17

8619. INVESTIGATION OF THE REACTION $O^{16}(\gamma,p)$ WITH 32 MeV BREMSSTRAHLUNG.

P.Brix and E.K.Maschke.

Z. Phys., Vol. 155, No. 1, 109-19 (1959). In German.

Photoprotons were detected in nuclear emulsion plates. Only tracks belonging to proton energies $E_p > 10$ MeV were measured. The spectrum of the photoprotons shows a maximum at $E_p = 11.2$ MeV. The angular distributions of various proton groups are peaked near the 90° angle with the peak shifting in the forward direction with increasing energy. At 28 MeV gamma energy the partial cross-section for transitions to the ground state of N^{15}, averaged over an energy range of 1.2 MeV, was determined to be 2.1 mb ±25%. The results are discussed.

539.17

8620. MEASUREMENT OF THE CROSS-SECTION FOR Ta^{181} $Ta^{181}(\gamma,p)Hf^{180}$ WITH γ-RAYS OF 14.8 AND 17.6 MeV.

W.Sebaoun and H.Gauvin.

C.R. Acad. Sci. (Paris), Vol. 248, No. 6, 791-3 (Feb. 9, 1959). In French.

With about twice as much γ of 17.6 MeV as of 14.8 MeV, the value $\sigma = (1.6 \pm 1.2) \times 10^{-26}$ cm^2 is reported (the γ-rays were obtained from $Li^7(p,\gamma)Be^8$). J.Lascoux

539.17

8621. (γ,p) REACTION IN COBALT.

M.Rozkoš.

Czech. J. Phys., Vol. 7, No. 5, 592-8 (1957). In Russian.

The nuclear emulsion method was used to measure the energy- and angular distribution of photoprotons from cobalt, irradiated by 17.6 and 14.8 MeV γ-photons from the Li(p,γ) reaction. The observed energy distribution agrees with the formula derived from the evaporation theory. The angular distribution is represented by an approximate empirical formula, which, however, is void of any consistent theoretical interpretation. P.Roman

539.17

8622. STUDIES OF THE YIELD OF THE (γ,p) REACTION ON VARIOUS CADMIUM ISOTOPES.

Go Tsi-di and B.S.Ratner.

Dokl. Akad. Nauk SSSR, Vol. 125, No. 4, 761-4 (April 1, 1959). In Russian.

The yields and cross-sections of the (γ,p) reactions on Cd^{112}, Cd^{113}, Cd^{114} and Cd^{116} were measured at bremsstrahlung energies of 15-30 MeV. The cross-sections were found to be between 2 and 15 mb at 20-21 MeV. The results are discussed briefly and compared with those of other workers. A.Tybulewicz

539.17

8623. PHOTONUCLEAR REACTIONS IN Pr^{141}.

F.Ferrero, R.Malvano, E.Silva, J.Goldemberg and G.Moscati.

Nuclear Phys., Vol. 10, No. 4, 423-8 (April (1), 1959).

The (γ, n) and (γ, 2n) reactions in Pr^{141} were studied up to 30 MeV by the method of residual activity. A comparison is made with the statistical theory of nuclear reactions revealing a partial disagreement at high energies. The total photo-absorption cross-section is evaluated and the integrated value is found to be greater than the theoretical predictions. The behaviour of the absorption cross-section in the region above the giant resonance is discussed.

539.17

8624. PHOTONEUTRON CROSS SECTION OF Ni^{58}.

J.P.Roalsvig, R.N.H.Haslam and D.J.McKenzie.

Canad. J. Phys., Vol. 37, No. 5, 607-13 (May, 1959).

The reaction $Ni^{58}(\gamma,n)Ni^{57}$ has been investigated between 12 and 24 MeV maximum photon energy. The absolute yield value at 22 MeV was found to be much lower than reported previously. Also, a shorter half-life of Ni^{57} was obtained. The cross-section was determined using two different methods.

539.17

8625. PHOTO ALPHA REACTIONS IN SILVER.

J.P.Roalsvig, R.N.H. Haslam, L.D.Skarsgard and E.E.Wuschke.

Canad. J. Phys., Vol. 37, No. 6, 722-9 (June, 1959).

The reaction $Ag^{109}(\gamma,\alpha)Rh^{105}$ has been investigated by using the secondary activity of Rh^{105}. Statistical theory was used to obtain information about the reactions $Ag^{107}(\gamma,\alpha)Rh^{103}$ and $Ag(\gamma,\alpha)Rh$. The present values for the absolute yield and cross-section are in agreement with previous work using either the secondary activity or photographic plates.

539.17

8626. PHOTOPROTONS FROM VANADIUM.

A.Halsteinslid, K.Nybø and R.B.Møllerud.

Univ. Bergen Arbok, 1958, No. 15, 9 pp.

The angular and energy distributions of protons from vanadium irradiated by 30 MeV bremsstrahlung were measured by means of nuclear emulsions. The energy distribution has a maximum at 4 MeV and a similar shape as previously found for medium heavy elements. The medium energy protons show a clear asymmetry in the forward direction.

539.17

8627. ON THE (γ,pn) REACTION IN ^{32}S.

U.Farinelli, F.Ferrero, S.Ferroni, R.Malvano and E.Silva.
Nuovo Cimento, Vol. 12, No. 1, 89-90 (April 1, 1959).

Measurements are reported of the (γ,pn) and also the (γ,n) cross-sections for γ-ray energies up to 33 MeV. S.J.Goldsack

539.17

8628. SEARCH FOR RESONANCE STRUCTURE OF NEUTRON CROSS SECTIONS AT 100 MeV.

S.G.Carpenter and R.Wilson.
Phys. Rev., Vol. 114, No. 2, 510-13 (April 15, 1959).

Resonances in neutron cross-sections were searched for near 100 MeV by a self-absorption method. A sign, barely significant, of resonance structure in antimony or cadmium was found, but if the resonance cross-section is 1.2 times the nonresonant cross-section, the resonances are present over only 3% of the energy band. The upper limit for the other elements is 1%. Differences of neutron total cross-sections were measured precisely for several adjacent elements and it was found that there are many deviations from a smooth curve as a function of $A^{2/3}$.

539.17

8629. SLOW-NEUTRON CROSS SECTIONS OF Pu^{240}, Pu^{242}, AND Am^{243}.

R.E.Coté, L.M.Bollinger, R.F.Barnes and H.Diamond.
Phys. Rev., Vol. 114, No. 2, 505-9 (April 15, 1959).

Measurements of the total cross-sections of Pu^{240}, Pu^{242}, and Am^{243} have been made using the Argonne "fast chopper". The results on Pu^{240} include only the resonance structure which could be studied through the Pu^{240} impurity in some samples of Pu^{239} which were used in an exhaustive study of the latter nuclide. The values of the resonance parameters of the resonances at 1.053, 20.4, and 38.2 eV comprise these results. The studies of Pu^{242} and Am^{243} were made possible by the separation of these nuclides from samples of Pu^{239} which had undergone extensive neutron irradiation. Resonances were observed at 2.65 and 53.6 eV in Pu^{242} and at 0.976, 1,353, 1.74, 3.42, 5.12, 6.54, 7.84, 10.3, 12.8, 13.1, and 15.3 eV in Am^{243}. Resonance parameters are reported for all of these resonances and in addition, the resonance capture integrals derived from these parameters are compared with the results of other measurements of these quantities.

539.17

8630. RADIATIVE-CAPTURE CROSS-SECTION FOR NEUTRONS FROM AN Sb—Be SOURCE.

J.F.Vervier.
Nuclear Phys., Vol. 9, No. 4, 569-76 (Jan. (2), 1959). In French.

The cross-sections of 7 isotopes were measured for 25 keV Sb—Be photoneutrons by comparison with the corresponding thermal neutron cross-sections; the agreement with previous measurements is satisfactory.

539.17

8631. THERMAL NEUTRON ABSORPTION CROSS SECTION OF Xe^{135}.

H.R.Fickel and R.H.Tomlinson.
Canad. J. Phys., Vol. 37, No. 5, 531-6 (May, 1959).

The effective neutron absorption cross-section of Xe^{135} has been measured with a mass spectrometer by observing the variation in the Cs^{135}/Cs^{137} fission yield ratio obtained at various thermal neutron fluxes. Values of 3.15 ± 0.06 megabarns and 3.27 ± 0.11 megabarns have been determined for neutron temperatures of 120°C and 137°C, respectively.

539.17

8632 RESONANT NEUTRON CAPTURE IN Er AND Hf.

C.A.Fenstermacher, J.E.Draper and C.K.Bockelman.
Nuclear Phys., Vol. 10, No. 4, 386-94 (April (1), 1959).

The low energy portion of the gamma-ray spectra was studied following neutron capture in the 0.47, 0.58, 6.0 and 9.4 eV resonances in erbium and the 1.10 and 2.38 eV resonances in hafnium. Measurements of the absolute intensities of the 192, 285, 750 and 820 keV peaks in erbium give essentially the same results for the four resonances. The relative intensity of the 80 keV peak was measured for thermal capture. The 285, 192 and 80 keV peaks are associated with the 6^+, 4^+, 2^+ and 0^+ rotational levels of Er^{168} and all four resonances (previously unassigned) are assigned to the target isotope Er^{167}. There is evidence that the 192 keV peak is composite. In hafnium the 90, 220 and 330 keV peaks are associated with the 0^+, 2^+, 4^+ and 6^+ rotational states of Hf^{178}. The relative intensities of the 220 and 330 keV peaks differ by the factor 2.7 for the 1.10 and 2.38 eV resonances producing Hf^{178}.

539.17

8633. INTERACTION OF FAST NEUTRONS WITH FLUORINE.

E.Kondaiah, C.Badrinathan and K.V.K. Iyengar.
Nuclear Phys., Vol. 9, No. 4, 561-8 (Jan. (2), 1959).

Fluorine targets were irradiated with fast neutrons arising from D(d, n), Be(d, n) and T(d, n) reactions using the deuterons accelerated in a 1 MeV Cockroft—Walton accelerator. Resulting charged particle spectra and low energy gamma ray spectra were studied. Using 15 MeV neutrons, the charged particle spectrum showed a small hump at (10.6 ± 0.8) MeV which is consistent with a 10.5 MeV alpha group leading to the ground state of N^{16} in F^{19}(n, α)N^{16} reaction. The gamma spectra showed mainly 110 ± 8 and 195 ± 10 keV gamma rays. Relative intensities of these gamma rays at each of the neutron energies are given. Gamma rays of 300 and 390 keV energy that might arise in F^{19}(n, α)N^{16} reaction were looked for but not observed. Upper limits on their intensities with respect to 110 keV gamma rays are given. No real coincidence effect was found between 110 and 195 keV gamma rays up to 10 μsec delay.

539.17

8634. .GAMMA RADIATION FROM THE U^{238}(n,γ)U^{239} REACTION.

P.J.Campion, J.W.Knowles, G.Manning and G.A.Bartholomew.
Canad. J. Phys., Vol. 37, No. 3, 377-81 (March, 1959).

γ-rays from the thermal neutron irradiation of 200 g of uranium containing only 0.034% of U^{235} were studied with a flat crystal diffraction spectrometer from 0.14 to 3.4 MeV, and with a pair spectrometer above 3 MeV. The energies and intensities of 10 resolved γ-rays from the capture reaction were measured, after the separation of those γ-rays from prompt fission and the β-decay of Np^{239}. No γ-rays which could be definitely ascribed to the U^{238}(n,γ)U^{239} reaction were observed above a peak at 4.062 MeV, which, however, is not the ground state transition, since measurements with two scintillators showed coincidences between the 4.062 MeV line and some unresolved radiation consistent with a binding energy of about 4.7 MeV. A.E.I. Research Laboratory

539.17

8635. THE Y^{89}(n,γ)Y^{90} REACTION.

G.A.Bartholomew, P.J.Campion, J.W.Knowles and G.Manning.
Nuclear Phys., Vol. 10, No. 5, 590-605 (April (2), 1959).

The thermal neutron capture gamma-rays from the Y^{89}(n,γ)Y^{90} reaction were investigated in the energy region between 0.18 and 7.0 MeV with a pair spectrometer, a flat crystal spectrometer, and an angular correlation arrangement using two sodium iodide crystals. The prominent gamma-rays in the spectrum, which is unusually simple for a nucleus of this mass number, can be fitted to a level diagram for Y^{90} with levels at 0.2024 ± 0.0003, 0.247 ± 0.002, 0.7767 ± 0.0002, 1.215 ± 0.002 and 2.741 ± 0.012 MeV. Angular correlation studies between cascading gamma-rays, with certain assumptions based on the gamma-ray intensities, lead to tentative assignments of 2+ and 3− for the levels at 0.7767 and 0.2024 MeV, respectively. The neutron binding energy of Y^{90} is found to be 6.849 ± 0.009 MeV. The observed level scheme is compared with shell model predictions.

539.17

8636. CROSS SECTIONS FOR SOME (n, p) AND (n, α) REACTIONS.

B.D.Kern, W.E.Thompson and J.M.Ferguson.
Nuclear Phys., Vol. 10, No. 3, 226-34 (March, 1959).

The cross-sections for the Mg^{24}(n, p)Na^{24}, Al^{27}(p, α)Na^{24}, Si^{28}(n, p)Al^{28}, Cr^{52}(n, p)V^{52} and Fe^{56}(n, p)Mn^{56} reactions were measured for neutrons produced by the H^{3}(d, n)He^{4} reaction. The activation method was used, with the gamma rays which are emitted following beta decay being counted with a NaI(Tl) scintillation crysta The Mg^{24}(n, p)Na^{24} cross-section is found to be 219 ± 26 mb at 13.0 MeV. The Al^{27}(n, α)Na^{24} cross-section varies smoothly from 139 mb at 13.0 MeV to 106 mb at 15.7 MeV. The Si^{28}(n, p)Al^{28} cross section changes smoothly from 370 mb at 12.3 MeV to 160 mb at 18.3 MeV, with a broad peak at 13.5 MeV with the maximum value o 380 mb. The Cr^{52}(n, p)V^{52} cross-section decreases slowly from 125 mb at 12.3 MeV to 72 mb at 18.3 MeV. The Fe^{56}(n, p)Mn^{56} cross section is found to be 131 ± 15 mb at 15.3 MeV. The results are generally in agreement in those cases where previous results of others exist.

539.17

8637. THE ENERGY AND ANGULAR DISTRIBUTION OF PROTONS FROM 14 MeV NEUTRON REACTIONS WITH Fe^{54}.

D.L.Allan.

Nuclear Phys., Vol. 10, No. 4, 348-59 (April (1), 1959).

The reactions Fe^{54}(n,p) and Fe^{54}(n,np) were studied. The Fe^{54} angular distributions and previously published angular distributions for Cu are corrected to the centre of mass system of coordinates and compared. The results indicate that there is a small contribution from the direct interaction of the incident neutrons with protons mainly in the surface of the target nucleus.

539.17

8638. (n, p) CROSS SECTIONS NEAR Z = 50.

H.P.Eubank, R.A.Peck, Jr and M.R.Zatzick.

Nuclear Phys., Vol. 10, No. 4, 418-22 (April (1), 1959).

Forward differential (n,p) cross-sections were measured with a proportional counter-scintillation counter telescope for 14.1 MeV neutrons on the following nuclei: Rh^{103}, Ag (natural), Cd (natural), In^{115}, Sn^{116}, Sn^{120}, Sb (natural) and Te (natural). The measurements were made with an angular spread of about $\pm 15^{\circ}$ and cover the proton energy range from 4 to 15 MeV. A decrease in differential cross-section occurs with increasing Z reaching a minimum at Z = 50 of about 1 mb/sterad, thereafter rising abruptly at Z = 51 to 40 mb/sterad. At Z = 52, the cross-section is again about 1 mb/sterad.

539.17

8639. EXCITATION FUNCTION OF THE REACTION Zn^{64}(n,p)Cu^{64} WITH NEUTRONS OF ENERGIES BETWEEN 2 AND 3.6 MeV.

J.Rapaport and J.J.van Loef.

Phys. Rev., Vol. 114, No. 2, 565-9 (April 15, 1959).

The relative cross-section for Zn^{64}(n,p)Cu^{64} has been measured by an activation method for neutron energies of 2.0 to 3.6 MeV. The absolute cross-section at 3.55 MeV neutron energy is found to be 56.4 ± 9.0 mb by comparing the Cu^{64} positron activity with the amount of Si^{31} formed in the P^{31}(n,p)Si^{31} reaction, which has a previously known cross-section of 96.2 ± 9.0 mb. The cross-section rises monotonically with increasing energy from a value of 12 mb at 2.0 MeV. The experimental results are compared with the predictions of statistical theory; experimental level densities are used in the calculations, but even so the predicted yield is too small. An upper limit of 2 mb is assigned to the cross-section for Zn^{68}(n,γ)Zn^{69*} at 3 MeV.

539.17 : 539.12

ANGULAR DISTRIBUTION OF PHOTO-NEUTRONS PRODUCED BY 17 MeV X-RAYS. See Abstr. 8458

539.17

8640. THE CAPTURE OF MUONS BY COMPLEX NUCLEI.

H.A.Tolhoek.

Nuclear Phys., Vol. 10, No. 5, 606-19 (April (2), 1959).

A comparison is made of different theoretical approaches for calculating the total rates for capture of muons by complex nuclei. The merits of the closure approximation and shell model calculations are discussed. The application of the closure approximation to a statistical model of the nucleus is worked out in some detail. A tentative explanation of the experimental data in terms of a universal Fermi interaction is given.

539.17

8641. ABSORPTION OF POLARIZED μ^--MESONS BY NUCLEI. THE NEUTRON ANGULAR DISTRIBUTION.

E.I.Dolinsky and L.D.Blokhintsev.

Nuclear Phys., Vol. 10, No. 5, 527-40 (April (2), 1959).

The angular distribution of neutrons emitted in the absorption of polarized μ^--mesons by nuclei is calculated. Numerical computations are carried out for O^{16} and Ca^{40}.

539.17

8642. ABSORPTION OF μ^- MESONS IN C^{12}.

H.V.Argo, F.B.Harrison, H.W.Kruse and A.D.McGuire.

Phys. Rev., Vol. 114, No. 2, 626-33 (April 15, 1959).

It is known that there is a strong similarity between the electron—nucleon and electron—muon weak interactions. This paper is a report on an experimental investigation of the third leg of the triangle, the muon—nucleon interaction. The absorption of negative cosmic-ray muons stopped in C^{12} was studied, and the probability per second of absorption resulting in the formation of B^{12} in the ground state was measured and found to be 9050 ± 950 sec^{-1}. This is compared to the known rate of β decay of B^{12} to the ground state of C^{12}, 33.2 ± 0.65 sec^{-1}. The ratio of the rates is 273 ± 29. In the allowed approximation, the nuclear matrix elements for the two processes are the same, and the ratio of the rates can be calculated in terms of the ratio of the coupling constants without assuming a nuclear model. The short wavelength of the neutrino emitted in μ absorption (13 fermis) causes forbidden matrix elements to make an important contribution to the μ-absorption rate, so that the theoretical prediction is dependent on the nuclear model. Within the uncertainties of the calculation, the electron—nucleon and muon—nucleon axial vector coupling constants are the same.

539.17

NUCLEAR REACTIONS DUE TO COSMIC RAYS. See also the Section entitled "COSMIC RAYS".

539.17

8643. PROMPT-NEUTRON EMISSION FROM SINGLE FISSION FRAGMENTS. S.L.Whetstone, Jr.

Phys. Rev., Vol. 114, No. 2, 581-5 (April 15, 1959).

With a Cf^{252} source placed at the edge of a large cadmium-loaded liquid scintillator, it was possible to obtain a measure of the number of prompt neutrons emitted from a single fission fragment of measured mass. The mass determination results from a concurrent time-of-flight measurement of the two fragment velocities. The 30 in. scintillator had a high detection efficiency, little dependent on the energy of the neutrons, and permitted-detection in a full hemisphere about the direction of one of the fragment flight paths. The average number of neutron counts per fission was found to increase with the mass number of the fragment approaching the neutron detector in much the same way in both the light- and heavy-fragment groups, with a sharp decrease occurring in passing from the light to the heavy group. A correction for the geometry of the neutron detection, assuming isotropic emission of the neutrons in the fragment frames, enhances slightly the sawtooth dependence of $\bar{\nu}$(A) and gives for the ratio of the average number of neutrons from the light fragment to that from the heavy fragment $\bar{\nu}_L/\bar{\nu}_H = 1.02 \pm 0.02$. One is led to believe that either the emission of the neutrons is far from isotropic or that the slightly lighter fragments posses considerably more excitation energy than the slightly heavier fragments when the mass division is nearly symmetric. Perhaps a new picture of the mass division is indicated.

539.17

8644. EXCITATION FUNCTIONS OF THE FRAGMENTS PRODUCED ON FISSION OF LANTHANUM.

A.K.Lavrukhina, L.D.Revina and E.E.Rakovskii.

Dokl. Akad. Nauk SSSR, Vol. 125, No. 3, 532-4 (March 21, 1959). In Russian.

Excitation functions (i.e. dependences of the formation cross-section on the energy of the incident particle) were obtained for P^{32}, Ni^{66} and Se^{73} produced on fission of lanthanum by 140-660 MeV protons. The excitation functions of Se^{73} and Ni^{66} were found to increase monotonically with the incident proton energy, while the excitation function of P^{32} has a maximum at 470 MeV.

A.Tybulewicz

539.17

8645. A SUGGESTED EXPLANATION FOR THE ANOMALOUS ANISOTROPIES IN HIGH ENERGY FISSION. I.Halpern.

Nuclear Phys., Vol. 11, No. 3, 522-30 (June (1), 1959).

Recent experiments on fission induced by high energy protons have shown that the angular distributions of fragments are peaked at right angles to the beam. The fission fragments thus come off mainly with orbital angular momenta oriented along the beam axis despite the fact that the angular momenta of the incident protons with respect to the nuclear centre are oriented perpendicular to this direction. This "anomaly" is attributed to the cooperation of two effects: (1) there are relatively many collisions of an incident proton with individual nucleons in a nucleus which result in angular momentum transfers to the nucleus along the beam axis. This is due to the nature of the nucleon—nucleon differential cross-section at high energy, (2) the collisions just described generally leave relatively small amounts of excitation energy in the nucleus. It has been shown that small excitation energies are particularly favourable for the production of large anisotropies.

539.17

8646. PILE NEUTRON CAPTURE CROSS SECTIONS OF Np^{239}.

E.M.Kinderman, H.W.Lefevre and H.H.Van Tuyl.

Nuclear Sci. Engng, Vol. 5, No. 4, 264-8 (April, 1959).

An activation method was used to measure the neutron capture cross-sections of Np^{239}. Two isomers of Np^{240} have been reported: a 7 min daughter of U^{240} and a 1 hr isomer produced by alpha bombardment of U^{238}. Examination with a gamma scintillation spectrometer of the activity produced by neutron activation of Np^{239} gave positive evidence for the 7 min isomer as a product of neutron capture in Np^{239}. The 1 hr isomer is also produced, although the evidence for it was complicated by fission product activity. Genetic linkage between the isomers was not detected and is less than 5%. The measured cross-sections for pile neutrons are 31 ± 6 barns and 18^{+18}_{-6} barns for the 7 min and 1 hr isomers. These values are based upon a 2.8% abundance of the 1.5 MeV gamma of the 7 min isomer and a 38% abundance for the 0.97 MeV gamma of the 1 hr isomer. These results are relative to a gold thermal cross-section of 99 barns.

539.17

8647. FISSION OF U^{238}.

M.N.Nikolaev, V.I.Golubev and I.I.Bondarenko.
Zh. eksper. teor. Fiz., Vol. 34, No. 3, 752-4 (1958). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 34(7), No. 3, 517-18 (Sept., 1958).

The distribution of fission neutrons in a hollow sphere of natural uranium of outside radius 25 cm and inside radius of 5 cm, when a disk of U^{235} at its centre was irradiated with a beam of thermal neutrons, was measured and used to calculate the number of fissions of U^{238} which take place in an infinite block uranium when a single fission neutron is admitted to the block. After corrections for the fission of U^{235} in natural uranium, and for leakage from the sphere, the value 0.17 ± 0.01 was obtained. This number is related to parameters of the Peierls single group model. S.J.Goldsack

539.17

8648. RATIO OF ASYMMETRIC TO SYMMETRIC FISSION OF U^{233} AS A FUNCTION OF NEUTRON ENERGY.

R.B.Regier, W.H.Burgus and R.L.Tromp.
Phys. Rev., Vol. 113, No. 6, 1589-92 (March 15, 1959).

Radiochemical measurements of the relative yields of the fission products Mo^{99}, Ag^{111}, Ag^{113}, and Cd^{115} from the low-energy neutron-induced fission of U^{233} were made at various neutron energies. The energies chosen were thermal, 1.8, 2.3, and 4.7 eV, the latter three corresponding to the peaks of previously reported resonances. It was found that the ratio of asymmetric to symmetric fission is larger at the 1.8 and 2.3 eV resonances than at thermal energies. At the 4.7 eV resonance, however, this ratio is the same as at thermal energy, to within experimental uncertainties. In addition, it was found that the ratio for epi-cadmium neutrons differed from that for thermal neutrons. The results are consistent with Wheeler's prediction that the ratio of asymmetric to symmetric fission should depend upon the spin state of the fissioning nucleus.

539.17

8649. ON THE STATISTICAL THEORY OF NEUTRON TRANSPORT. G.Kosály.

Nukleonik, Vol. 1, No. 6, 221-4 (June, 1959).

The behaviour of a stable particle travelling in a non-multiplying medium is studied. By taking into consideration the fact that certain parameters characterizing the state of the particle are probability variables representing a stochastic process of Markoffian type, the second Kolmogoroff–Feller equation is derived and found to be equal to the known kinetic equation. As an additional variable the number of collisions is also introduced into this equation and the space dependence of the macroscopic cross-sections is taken into account. After treating the special case of a steady state, the behaviour of neutrons in the slowing down region is considered. As an application one derives the probability $p_N(u,\mu)du d\mu$ that the neutron lethargy will be changed in the course of N collisions by a value lying in the interval $(u, u + du)$, and that the cosine of the angle between the initial and final direction of the flight of neutrons lies in the interval $(\mu, \mu + d\mu)$. Upon integrating with respect to the lethargy, the density function of the probability variable μ can be determined. The mean value and the mean square deviation of μ is also derived.

539.17

8650. THE THERMAL NEUTRON SPECTRUM IN A HETEROGENEOUS REACTOR. H.Takahashi.

Nuclear Sci. Engng, Vol. 5, No. 5, 338-46 (May, 1959).

In the case of heterogeneous reactors, the absorption in fuels is so strong that the thermal neutron energy spectrum in the fuel will have a higher energy than in the moderator. The different temperatures of these media will also cause a difference of spectra. The thermal neutron energy spectra of each medium in a heterogeneous reactor are studied. The thermal neutron energy spectrum and the neutron temperature in light-water moderated and UO_2 fuelled reactors were calculated by a numerical method and the approximate Wigner–Wilkins method.

539.17 : 539.12

THERMALIZATION OF NEUTRONS IN INFINITE HOMOGENEOUS SYSTEMS. See Abstr. 8463

539.17

8651. THE CONSIDERATION OF AIR SPACES IN THE NEUTRON DIFFUSION THEORY WITH APPLICATION TO THE TWO REGION REACTOR. D.Bünemann.

Atomkernenergie, Vol.2, No. 11-12, 452-6 (Nov.-Dec., 1957).
In German.

Diffusion theory is not applicable in air spaces; however, transfer conditions across these spaces can be obtained. These conditions are worked out for spherical symmetry in two ways: (1) using Marshak's boundary conditions; (2) using boundary conditions obtained from calculations of the flux and neutron current at the surface. This is then applied to the two region breeder reactor of Bagge, where the air space lies between the core and breeder shell. The decoupling due to the air space is discussed and the conversion factor estimated. D.H.Lord

539.17

8652. REDUCED DELAYED NEUTRON GROUP REPRESENTATIONS. R.E.Skinner and E.R.Cohen.

Nuclear Sci. Engng, Vol. 5, No. 5, 291-8 (May, 1959).

It has been shown that a two-delayed neutron group model will accurately represent the asymptotic behaviour of the reactor transfer function. Correspondingly, the requirement that this asymptotic behaviour be accurately represented is sufficient to specify completely the two-delayed neutron group constants. Further, a three-delayed neutron group model has been evolved which is designed to represent both the asymptotic behaviour of the transfer function and shutdown behaviour. The inhour equation, transfer function, and transient behaviour for step inputs of reactivity with and without reactivity feedback loops for the two- and three-delayed neutron group representations are compared with those given by the standard one-group and many-delayed neutron group treatments. Important consequences of such reduced group representations are savings in machine time in making kinetic studies and increased tractability of the reactor kinetic equations.

539.17

8653. ON THE QUESTION OF THE INFLUENCING OF THE NEUTRON DISTRIBUTION BY THIN LAYERS. P.S.Pütter.

Atomkernenergie, Vol. 2, No. 4, 125-9 (April, 1957). In German.

In many reactors there are regions (such as cooling spaces and fuel cans) in which the diffusion theory is not applicable because their dimensions are less than the free neutron wavelength. Starting from equations similar to those of Newmarch, the effects on the neutron flux and current by plane, cylindrical and spherical evacuated spaces are calculated in matrix form. Further modifications of the basic equations enable the effects of thin layers of weak and strong scattering and absorbing media to be calculated for a plane geometry. D.H.Lord

539.17 : 539.12

8654. ON THE AVERAGE AND THE FLUCTUATION OF SLOWING DOWN TIME OF NEUTRONS IN HEAVY MODERATORS.

G.Kosály and G.Németh.
Nukleonik, Vol. 1, No. 6, 225-7 (June, 1959).

The average and the mean square deviation of the slowing-down time of neutrons are derived for heavy moderators. The present results are compared with those obtained by the Fermi as well as the Greuling–Goertzel, approximations.

539.17

8655. SOME ASPECTS OF THE CHOICE OF AN ECONOMICALLY WORKING HEAVY WATER, HETEROGENEOUS REACTOR WITH NATURAL URANIUM. H.Engel.

Atomkernenergie, Vol. 2, No. 2, 45-50 (Feb., 1957). In German.

The various economically important design points in such a reactor are reviewed, e.g. the cost of D_2O, the consumption of uranium, the production of plutonium, the operating temperature and power output. It is shown that a hot-water reactor (steam temperature 255°C) using a "double lattice" of fuel elements, and with an output of 1000 MW, is an economic possibility compared with coal. D.H.Lord

539.17

8656. THE TRANSPORT THEORY TREATMENT OF SMALL, CRITICAL PIECES OF FUEL. I. K.O.Thielheim.
Atomkernenergie, Vol. 2, No. 4, 121-5 (April, 1957). In German.

For critical systems which are small compared with the neutron wavelength, the diffusion theory is not applicable because of edge effects. Thus the transport theory is used to determine the critical mass, eigenvalues and collision probabilities for both single and multi-group neutrons in a sphere and in an infinite plate of fissionable material. It is assumed that the fuel is homogeneous, that the elastic scattering is isotropic, and that the neutron sources are only due to fission. D.H.Lord

539.17

8657. CALCULATION OF INFINITE MULTIPLICATION FACTOR FOR DOUBLE LATTICE. H.Engel.
Atomkernenergie, Vol. 2, No. 5, 168-76 (May, 1959). In German.

A "double lattice" reactor is defined as one in which the conventional lattice is made up of fuel elements of which each is a grid (or lattice) of uranium bars. Such an arrangement clearly offers heat-transfer advantages inasmuch as the coolant can mix more intimately with the fuel. It is also shown, on the basis of standard lattice calculations, that for a given fuel/moderator ratio an increase of 10 percent in the infinite multiplication constant may be achieved for certain geometries. J.W.Gardner

539.17 : 541.15

8658. ORGANIC COMPOUNDS AS MODERATORS AND COOLING MEDIA IN NUCLEAR REACTORS. S.Rösinger.
Atomkernenergie, Vol. 2, No. 5, 176-81 (May, 1957). In German.

Experiments to investigate the chemical effects (e.g. evolution of gas and polymerization) of radiation on various organic compounds, e.g. naphthalene, anthracene and polyphenyls, are described. The results are summarized as a comparison between water and organic moderators on the following points: highest working temperature and pressure; corrosion, activity, surface properties and the effects of irradiation. It is noted that the use of polyphenyls would enable reactors with negative temperature coefficients of reactivity to be built. D.H.Lord

539.17

8659. THE DEPENDENCE OF THE OUTPUT OF GAS-COOLED NUCLEAR REACTORS ON COOLING GAS PRESSURE AND THE REACTOR DIMENSIONS. A.Schraud.
Atomkernenergie, Vol. 2, No. 6, 204-7 (June, 1957). In German.

The reactor core discussed is a cylindrical graphite block containing a large number of parallel channels; the fuel rods stand concentrically in these channels. The cooling efficiency, heat transfer, pressure drop along a channel and gas throughput are examined with reference to reactor dimensions, gas pressure and maximum permissible temperatures. D.H.Lord

539.17

8660. ON THE CALCULATION OF THE CONVERSION OF MATTER IN A NUCLEAR REACTOR. H.Grümm.
Atomkernenergie, Vol. 2, No. 10, 401-7 (Oct., 1957). In German.

This is of importance for reasons such as the build up of neutron poisons and the economically valuable production of fissionable materials and isotopes. The equations for the various types of conversion (e.g. β-decay, fission and neutron capture) are set up for matter that is stationary in the reactor. With these equations and diffusion theory, the case of small concentration changes is studied. Further topics examined are the reactivity effect and the mixing of the reactor's contents. Several examples are given, e.g. Pu^{239} production. D.H.Lord

539.17

8661. UNSYMMETRIC DISTRIBUTION OF FUEL MATERIAL IN REACTORS TO PRODUCE CONSTANT POWER DENSITY PER UNIT VOLUME. F.Winterberg.
Atomkernenergie, Vol. 2, No. 11-12, 456-66 (Nov.-Dec., 1957). In German.

In a heterogeneous reactor where, for example, the moderator is the coolant, if the moderator flows with constant velocity then constant power density can be obtained with an unsymmetrical fuel distribution. This distribution is calculated for plane, spherical and cylindrical symmetry using both Fermi—Age and multi-group diffusion theories, taking into account resonance absorption and fast fission. The time dependence of the reactor's criticality and reactivity is investigated. D.H.Lord

539.17

8662. THE BEHAVIOR OF A REACTOR AT PROMPT CRITICAL WHEN THE REACTIVITY IS A LINEAR FUNCTION OF TIME. J.E.Wilkins, Jr.
Nuclear Sci. Engng, Vol. 5, No. 4, 207-14 (April, 1959).

A simple analytic formula is derived for the values of the prompt neutron density, the delayed neutron emitter densities, and the period in a reactor at the instant it has become prompt critical under the assumption that it has been brought to a prompt critical state from an arbitrary sub-prompt critical initial state by introducing reactivity at the constant rate of a dollars per second. For a fixed value of a, these formulae are asymptotic with respect to small values of the dimensionless parameter al/β, in which l is the mean lifetime of a neutron in the reactor and β is the fraction of fission neutrons which are delayed. For fast reactors, the quantity $1/\beta$ is generally small, so that the present formulae should be useful in estimating the power rise at prompt critical unless the rate of introduction of reactivity is quite large.

539.17

8663. ON THE TERMINATION OF REACTOR EXCURSIONS. J.MacPhee.
Nuclear Sci. Engng, Vol. 5, No. 5, 273-84 (May, 1959).

The response of a reactor to step changes in δk is reviewed for two cases; small positive changes in δk, and changes in δk greater than β. Analytical expressions are derived which give the negative change in δk required to terminate each type of excursion. Expressions for obtaining power overshoot are also obtained for each case for various types of δk removal. The analytical results are confirmed by more exact calculations with an analogue and a digital computer. It is shown that to terminate an excursion produced by a change in $\delta k < \beta$, it is only necessary to reduce δk at a rate such that zero δk is reached in about $2\frac{1}{2}$ sec. The fact that, to terminate a super-prompt-critical excursion, it is only necessary to reduce δk to a value equal to approximately β, is demonstrated analytically.

539.17

8664. THERMAL ACTIVATION SHAPES IN A WATER-MODERATED CRITICAL ASSEMBLY. M.Goldsmith and T.M.Ryan.
Nuclear Sci. Engng, Vol. 5, No. 5, 299-305 (May, 1959).

A method of computing thermal activation shapes in critical assemblies is formulated and compared with experiment. Corrections are made for local variations of the flux and for inadequacies of diffusion theory. For the assemblies studied, these corrections range between 4 and 10 per cent of the calculated thermal activation; a more important change of approximately 20 per cent is introduced by taking account of the core and reflector thermal spectra.

539.17

8665. MEASUREMENT OF THE DOPPLER TEMPERATURE EFFECT IN AN EBR-I TYPE ASSEMBLY.
W.Y.Kato and D.K.Butler.
Nuclear Sci. Engng, Vol. 5, No. 5, 320-30 (May, 1959).

A measurement of the Doppler temperature effect has been made in the fast spectrum of a mock-up of the EBR-I reactor in ZPR-III. The effect was measured by thermal cycling samples of enriched uranium, natural uranium, and plutonium and detecting the small changes in reactivity. The pile oscillation technique using a resonant detector was employed to measure the small oscillating component of the neutron flux. An upper limit of $0.5 \times 10^{-8}\ \Delta k/\Delta T$ was obtained for a 506 g sample of U^{235} in the spectrum of an EBR-I mock-up, and for a 235 g sample of Pu^{239} in a plutonium-fuelled assembly of the same configuration. The results for natural uranium were inconclusive.

539.17

8666. DETERMINATION OF REACTOR KINETIC PARAMETERS BY PILE NOISE ANALYSIS. C.E.Cohn.
Nuclear Sci. Engng, Vol. 5, No. 5, 331-5 (May, 1959).

An experimental investigation was made of the statistical fluctuations in neutron intensity which occur in a nuclear reactor. An ion chamber was exposed to reactor flux, and the fluctuations in its output current were analysed in a tunable bandpass filter to get the frequency spectrum of these fluctuations, which has the shape of the square modulus of the transfer function. Results are presented of some measurements made on various low-power experimental reactors at Argonne National Laboratory. For reactors with prompt neutron lifetime between 15 and 70 μsec, the quantity $1/\beta$ was determined within 5 per cent or better from a least squares fit to the transfer function thus measured.

ATOMS

539.18

8667. SOMMERFELD'S FINE-STRUCTURE FORMULA FROM FIVE DIMENSIONAL WAVE-EQUATION. C.C.Banerjee.
Indian J. Phys., Vol. 31, No. 5, 242-6 (May, 1957).

Sommerfeld's fine structure formula (1916) in exact form is derived from a five dimensional wave equation. It appears that the fifth coordinate influences the energy in the same way as the spin.

539.18

8668. ON THE 3d(^{1}D) AND 3d(^{1}S) LEVELS OF SINGLY IONIZED ARGON. L.Minnhagen.
Ark Fys., Vol. 14, Paper 9, 123-5 (1958).

The locations of the levels: $^2S_{\frac{1}{2}}$, $^2P1_{\frac{1}{2}}$, $^2P_{\frac{1}{2}}$, $^2D2_{\frac{1}{2}}$, $^2D1_{\frac{1}{2}}$, $^2F3_{\frac{1}{2}}$, $^2F2_{\frac{1}{2}}$, $^2G4_{\frac{1}{2}}$, $^2G3_{\frac{1}{2}}$ of the 3d(^{1}D) term and of the levels: $^2D2_{\frac{1}{2}}$, $^2D1_{\frac{1}{2}}$ of the 3d(^{1}S) term of singly ionized argon have been satisfactorily determined. R.W Nicholls

539.18

8669. ATOMIC ENERGY LEVELS. VOLUME II. C.E.Moore.
Circ. Nat. Bur. Stand., No. 467, xxxi + 227 pp. (1952).

For Vol. I, see Abstr. 7202 (1949). The present volume covers the elements from chromium to niobium, inclusive.

539.18

8670. ATOMIC ENERGY LEVELS. VOLUME III. C.E.Moore.
Circ. Nat. Bur. Stand., No. 467, xxxviii + 245 pp. (1958).

This volume covers the elements from molybdenum to lanthanum and from hafnium to actinium. See also Abstr. 5089 (1959).

539.18

8671. APPLICATION OF A UNITARY TRANSFORMATION TO THE CALCULATION OF ATOMIC ENERGY LEVELS. O.S.Petrov.
Optika i Spektrosk, Vol. 5, No. 3, 225-35 (1958). In Russian.
English summary: PB 141047T-7, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

In an attempt to improve on the conventional perturbation theory a general unitary transformation [exp(iS)] is applied to the energy matrix [H] whereby the matrix S is Hermitean. Separating the energy into its diagonal [D] and non-diagonal [N] part, S is chosen in such a way that N = iSD. By expanding the transformed energy matrix in powers of S a perturbation series of the usual kind is obtained which has the merit of rapid convergence. Also it is relatively simple to give general expressions for the higher terms in the series. The method is applied to ions of two and three electrons. Results are given in the form of formulae and numerical tables. R.Eisenschitz

539.18

8672. ON THE MAGNETIC RESONANCE OF ATOMIC LEVELS OF MERCURY EXCITED BY ELECTRON BOMBARDMENT.
J.P.Descourbes and J.C.Pebay-Peyroula.
C.R. Acad. Sci. (Paris), Vol. 247, No. 25, 2330-2 (Dec. 22, 1958).
In French.

Magnetic resonances have been detected upon the lines λλ 3651, 5461, 4358, 4047, 6123A of Hg. Similar resonances have been detected for the lines λλ 5688, 5682, 4983, 4978 of Na. They lead to lifetimes of 5×10^{-8} sec. for $4^2D_{5/2}$ and 2×10^{-8} sec for $5^2D_{5/2}$ of Na. R.W.Nicholls

539.18

8673. COMBINED USE OF THE METHODS OF SUPERPOSITION OF CONFIGURATIONS AND CORRELATION FACTOR ON THE GROUND STATES OF THE HELIUM-LIKE IONS.
P.O.Löwdin and L.Rèdei.
Phys. Rev., Vol. 114, No. 3, 752-7 (May 1, 1959).

The accurate solution of the Schrödinger equation by means of a combination of the method of correlation factor and the method using superposition of configurations is discussed. For a many-electron system, the total wave-function divided by the nodeless function $g = g(r_{12}, r_{13}, r_{23} \cdots)$ may be expanded in a series of Slater determinants built up from a complete one-electron set. For a two-electron system, this expansion becomes very simple and, by going over to principal orbitals, it may be "diagonalized" and brought to a particularly rapidly convergent form. The method is applied to the He-like ions (H^-, He, Li^+, and Be^{2+}) by choosing $g = 1 + \alpha r_{12}$ and by using a basis consisting of only three s-orbitals. The energies obtained differ from the exact values only by about 0.001-0.002 atomic units. Even the simpler wave-functions $(u)^2(1 + \alpha r_{12})$ and $(u,v)(1 + \alpha r_{12})$ are discussed, and the forms obtained by truncating the expansion of Ψ in principal orbitals are studied in greater detail.

539.18

8674. THE REPULSION POTENTIAL OF UNOCCUPIED STATES. E.Antončik.
Czech. J. Phys., Vol. 7, No. 1, 118-19 (1957).

In order to obtain an idea of the advantages of using the repulsion potential introduced by Hellmann [Acta Physicochimica, Vol. 1, 913 (1935)] for the case when some states of the ion are not occupied, some excited states of the hydrogen atom were calculated and the results compared with the known exact solutions. It was found that use of the repulsion potential can reproduce, in certain cases, the total energy and the wave-function with sufficient accuracy. P.Roman

539.18

8675. THE FORMULATION OF ISOTOPE SHIFTS FOR HEAVY ATOMS. N.Ionesco-Pallas.
C.R. Acad. Sci. (Paris), Vol. 248, No. 2, 199-202 (Jan. 12, 1959).
In French.

A general formula for the isotope shift of an electronic $S_{1/2}$ level is obtained by a perturbation calculation, assuming the nuclear charge distribution to be uniform. For heavy atoms, this can be expressed as a universal curve, which fits experimental results reasonably well. J.Hawgood

539.18

8676. ON THE 3d WAVE FUNCTIONS IN ATOMS OF THE IRON GROUP. I.Fidone.
Nuovo Cimento, Vol. 11, No. 5, 736-7 (March 1, 1959).

The mean value of r^{-3} was calculated for 3d orbitals for elements from Sc to Cu. The results agree well with those obtained from h.f.s. experiments. J.Hawgood

539.18

8677. HE I GROUND-STATE WAVE FUNCTION OF THE FORM $\Psi = f(r_1)f(r_2)g(r_{12})$. L.C.Green, C.Stephens, E.K.Kolchin, C.C.Chen, P.P.Rush and C.W.Ufford.
J. chem. Phys., Vol. 30, No. 4, 1061-5 (April, 1959).

A variational trial wave-function of the form $\Psi = f(r_1)f(r_2)g(r_{12})$ is applied to the ground state of He I. Firstly f(r) is taken to be an arbitrary function and $g(r_{12})$ is taken as linear. The form of f(r) and the slope of $g(r_{12})$ are chosen to yield the minimum energy. The energy, $-5.79613\ R_{He}hc$, and the form of f are compared with the results of earlier work and with the results obtained with analytic functions. A table of f(r) and the charge distribution is given. The charge distribution is compared with that obtained from a Hartree—Fock wave function and the difference is discussed. Secondly, f(r) is taken as an exponential and $g(r_{12})$ is taken to be an arbitrary function. The coefficient in the exponent in f(r) and the form of $g(r_{12})$ are chose to yield the minimum energy. The energy, $-5.78252\ R_{He}hc$, and the form of f are compared with the results obtained with analytic wave functions. The behaviour of g is shown in a table and by its asymptotic series. The probable effectiveness of Ψ if both f(r) and $g(r_{12})$ are taken as arbitrary is discussed.

539 18

8678. VALENCE-STATE IONIZATION POTENTIALS OF CARBON
I.J.Goldfarb and H.H.Jaffé.
J. chem. Phys., Vol. 30, No. 6, 1622-3 (June, 1959).

These are evaluated for various hybridizations for carbon I and II, mainly from spectroscopic data. J.Hawgood

539.18

8679. SELF-CONSISTENT FIELD WITHOUT EXCHANGE FOR DOUBLY IONIZED COBALT.
M.Ariyama, K.Kayama and M.Sugimoto.
J. Phys. Soc. Japan, Vol. 12, No. 3, 285-91 (March, 1957).

A self-consistent field without exchange for Co^{++} ion has been calculated and the tables of the results are given. Preliminary calculations were carried out with the aid of the differential analyse and the final results were obtained by the numerical integration. In the final approximation, the difference between estimated and calculated values of the contribution to Z_p from each subshell does not exceed 0.01 at any radius.

539.18

8680. STEPWISE EXCITATION OF MERCURY ATOMS BY ELECTRON IMPACT. K.I.Rozgachev.
Optika i Spektrosk., Vol. 4, No. 5, 549-54 (1958). In Russian. English summary: PB 141047T-2, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

Mercury atoms were bombarded with electrons of energy high enough to excite the $6^3P_{0,1,2}$ levels but not higher levels; some atoms were further excited by second collisions, and the intensities of the resulting emission lines were measured, giving the cross-section for the excitation to 7^3S as 3×10^{-16} cm^2. Full experimental details are given, as are the results of varying mercury vapour pressure, electron energy and collector current. J.Hawgood

539.18 : 539.19

8681. EFFECT OF THE CORE ON TRANSITIONS OF OPTICAL ELECTRONS. I.B.Bersuker.
Optika i Spektrosk., Vol. 3, No. 2, 97-103 (Aug., 1957). In Russian.

A many-electron system (an atom or a molecule) with a small number, k, of optical electrons is considered. The motion of the optical electrons is separated from that of the internal ones by the adiabatic approximation. Inertialess polarization of the inner-electron core, produced by an incident light wave, introduces an additional perturbation term in the expression for the optical-electron energies. This term accounts satisfactorily for the departure of the experimental values of the sum of oscillator strengths from unity. For example the uncorrected oscillator sum of Na is calculated to be 1.031. With the correction for the interaction with the inner-electron core included this sum becomes 1.276, compared with 1.26 obtained experimentally. New electron transitions due to the core interaction are found in certain molecules, e.g. in O_2. A.Tybulewicz

539.18 : 539.14

ZEEMAN INVESTIGATIONS OF ELECTRONIC ENERGY LEVELS OF Cm^{242}. See Abstr. 8508

539.18 : 539.12

8682. DEPOLARIZATION OF μ^--MESONS IN μ-MESIC ATOM FORMATION. I.M.Shmushkevich.
Nuclear Phys., Vol. 11, No. 2, 419-31 (May (3), 1959).

For not very highly excited states the level width in μ-mesic atoms is considerably smaller than the distance between fine structure levels. Spin—orbit interaction should therefore lead to considerable depolarization of μ^--mesons involved in the formation of μ-mesic atoms. The magnitude of this effect is estimated. The influence of hyperfine splitting of the μ-mesic atom ground state on the angular distribution of neutrons created in the capture of μ^--mesons by nuclei is also considered.

539.18

8683. NOTE ON THE QUADRUPOLE INTERACTION ENERGY IN μ-MESIC ATOMS. J.von Behr and H.Marschall.
Nuclear Phys., Vol. 11, No. 4, 670-4 (June (2), 1959). In German.

The calculation of the influence of a deformed nucleus on the fine structure of meson-atomic spectra requires a model of the charge distribution. The usual model involves an additional surface charge on a spherical nucleus. A more realistic, but still simplified model, represents the nucleus as a spheroid with constant charge density. It is pointed out that the difference between the two models are of the same order of magnitude as the relativistic corrections of the quadrupole-energy.

539.18

8684. OXYGEN ISOTOPE FRACTIONATION IN THE SYSTEM CALCIUM CARBONATE—WATER. R.N.Clayton.
J. chem. Phys., Vol. 30, No. 5, 1346-50 (May, 1959).

The oxygen isotope exchange reaction between water and calcium carbonate has been studied over the temperature range 190°C to 750°C. Equilibrium constants for the reaction have been measured and fit the equation: $\ln K = 2725T^{-2}$ for all temperatures above 0°C. The implications to geological thermometry are discussed.

539.18

8685. SEPARATION OF THE HYDROGEN ISOTOPES BY PREFERENTIAL ADSORPTION AT 20.4°K.
D.White and W.J.Haubach.
J. chem. Phys., Vol. 30, No. 5, 1368-9 (May, 1959).

The apparatus was a modified version of a single stage ortho—para separator containing γ-alumina. The (large) magnitude of the separation factors can be accounted for from thermodynamic considerations. W.Good

539.18

8686. ISOTOPE ENRICHMENT FACTORS FOR NITROGEN-15 IN THE NITRIC OXIDE—NITRIC ACID EXCHANGE SYSTEM.
L.N.Kauder, T.I.Taylor and W.Spindel.
J. chem. Phys., Vol. 31, No. 1, 232-5 (July, 1959).

Single stage enrichment factors, α, for the isotope exchange reaction of N^{15} between oxides of nitrogen and solutions of nitric acid have been determined by two different methods. Single stage equilibrations resulted in values of α that decrease from 1.065 for approximately 1M HNO_3 to 1.045 for 11.1 M HNO_3. At high acid concentrations, α decreases rapidly owing to high concentrations of NO_2 and N_2O_4 in the gas phase. Steady-state over-all separations in an exchange column at several rates of product withdrawal gave an independent determination for the 10M HNO_3 used in the preparation of highly enriched N^{15}. Data from the two methods result in a value for α of 1.055 ± 0.005 for approximately 10M HNO_3 at 25°C.

539.18

8687. ISOTOPE TRANSPORT IN MOLTEN RUBIDIUM METAL AT DIFFERENT TEMPERATURES. A.Lodding.
Z. Naturforsch., Vol. 14a, No. 1, 7-9 (Jan., 1959). In German.

After passing currents of 10 amps for about 300 hours through tubes of molten rubidium at different temperatures, it was found that the greatest separation of Rb^{85} and Rb^{87} occurred at 140°C; significantly lower separations occurred at 100°C and 270°C. R.G.Chambers

539.18 : 541.14

8688. FIXATION OF NITRIC OXIDE ON MERCURY VAPOUR IRRADIATED BY ITS RESONANCE LINE λ_0 = 2537 Å.
J.L.Cojan and R.Taboué.
J. Phys. Radium, Vol. 19, No. 12, 960-1 (Dec., 1958). In French.

Describes an experiment in which the most abundant isotopes of Hg were enriched in the product of the reaction of NO with Hg atoms excited by this radiation, because of the greater intensity of the corresponding hyperfine components. J.Hawgood

539.18 : 539.231

LOW-ENERGY SPUTTERING YIELDS IN Hg. See Abstr. 7541

539.18

8689. THE TOTAL CROSS-SECTION AND THE DIFFUSION-SCATTERING CROSS-SECTION OF HARTREE POTENTIALS. T.Tietz.
Ann. Phys. (Leipzig), Folge 7, Vol. 2, No. 7-8, 387-92 (1959). In German.

Using analytical expressions (sums of exponentials) for the Hartree potentials of neutral atoms (Abstr. 2304 of 1957), results are obtained in the first Born approximation. W.A.Hepner

539.18 : 541.127

8690. IDEALIZED THEORY OF THE RECOMBINATIONS OF ATOMS BY THREE-BODY COLLISION.
D.W.Jepsen and J.O.Hirschfelder.
J. chem. Phys., Vol. 30, No. 4, 1032-44 (April, 1959).

A simple method is given for following the collision dynamics of three potential well molecules restricted to move on a line. The method can be applied to similar simple potentials which involve rigid core repulsion. An expression for the reaction rate for the recombination of atoms is derived in terms of a flux integral over the range of the reaction paths across the Eyring potential surface. The rate is calculated for atoms which interact according to a potential very similar to the potential well model. Finally, the simple reaction $A + BC \rightarrow AB + C$ is studied by these methods.

539.18

8691. COLLISIONS BETWEEN EXCITED CADMIUM ATOMS AND CAESIUM ATOMS. H.Friedrich and R.Seiwert.
Ann. Phys. (Leipzig), Vol. 20, No. 1-6, 215-29 (1957). In German.

The resonance behaviour of cross-sections for collisions between Cd and Cs atoms in a vapour mixture was measured through relative intensities of the line-series of Cs excited by sensitized fluorescence with the Cd intercombination line 3261 A. R.W.Nicholls

539.18 : 537.533 : 551.510.535

8692. CHARGE TRANSFER REACTIONS.
S.N.Ghosh and W.F.Sheridan.
Indian J. Phys., Vol. 31, No. 7, 337-52 (July, 1957).

An improved method for determining charge transfer cross-sections has been applied to symmetric and unsymmetric reactions for a large number of gases. This method shows higher cross-sections than the ones originally reported, and also that the variations in cross-sections between 150 and 800 eV ion energy are small. Unsymmetric reactions having nearly equal ionization potentials for the reacting particles are found to possess the character of a symmetric charge transfer reaction. Certain other unsymmetric reactions are found to possess the same character even though the ionization potentials are not equal. The method has been utilized to determine secondary electron emission from a metal surface by ion bombardment. Relating the variation of emission from a brass plate with the ion mass and energy, it is found that the emission varies inversely as the square root of the ion mass and directly with the energy of ions. Data for charge transfer cross-sections have been applied to certain upper atmospheric phenomena.

539.18

8693. NEGATIVE ATOMIC IONS. H.R.Johnson and F.Rohrlich.
J. chem. Phys., Vol. 30, No. 6, 1608-13 (June, 1959).

A semiempirical method is proposed for the computation of the electron affinities of negative atomic ions by extrapolation from the ionization potentials of the corresponding isoelectronic sequences. The method is based on a formula which can be justified on physical grounds and of which at least two parameters have direct physical interpretation. The results for the two short periods agree with experiments, with the exception of S^-. The poorly determined ionization potentials of its sequence may well be responsible for part of this discrepancy. The method predicts a stable N^- ion of small binding energy. The excited states and the fine-structure splitting can also be obtained by extrapolation based on theoretical formulae. The use of these formulae seems preferable to the method by Bates and Moisewitsch, but the results on excited states are the same. These results make it appear likely that metastable excited states exist in B^-, Al^-, and P^-.

539.18

8694. OPTICAL RESONANCE IN CADMIUM VAPOUR WITH SEPARATED ODD AND EVEN ISOTOPES. M.Spitzer.
C.R. Acad. Sci. (Paris), Vol. 248, No. 6, 786-7 (Feb. 9, 1959).
In French.

Experiments with the 3261 A line for the isotopes of mass 111, 113 and 114 show that the polarization depends on the nuclear spin.

J.Hawgood

MOLECULES

539.19 : 539.27

OBSERVATION OF MOLECULES BY FIELD EMISSION MICROSCOPY. See Abstr. 7544

539.19

8695. FREE RADICAL STATISTICS. P.L.Chessin.
J. chem. Phys., Vol. 31, No. 1, 159-62 (July, 1959).

On the basis of the Ising model, average concentrations of trapped free radicals condensed from a gas are obtained. The trapped free radical concentration is obtained as a function of various lattice configurations. Trapped free radical concentrations range from 16% for a one-dimensional lattice to 6.5% for a face-centred cubic lattice.

539.19 : 530.162

8696. EQUILIBRIUM STATISTICAL MECHANICS OF DISSOCIATING DIATOMIC GASES. L.Heller.
Phys. of Fluids, Vol. 2, No. 2, 147-52 (March-April, 1959).

For the diatomic molecule AB in thermal and chemical equilibrium with its dissociated atoms, the pressure, density, specific entropy, and specific enthalpy are written as functions of the temperature and the fractional dissociation, with the approximations that the rotation is fully excited and there is no electronic excitation. These approximations are very good for many molecules over a large range of the variables. Atoms A and B can be either identical or distinct provided there is no excess of one atom over the other. For molecules composed of the isotopes of hydrogen, because of their large vibrational energies, it is possible to have considerable dissociation without vibration being important. If vibration is neglected, then the thermodynamic variables (written in dimensionless form) are related by equations which do not involve any properties of the species under consideration. Curves of constant pressure, density, specific entropy, and specific enthalpy are presented in the temperature-dissociation plane. The errors introduced by neglecting vibration are proportional to exp $(-T_V/T)$, where T_V is the vibrational temperature.

539.19

8697. BROKEN BOTTLENECKS AND THE FUTURE OF MOLECULAR QUANTUM MECHANICS. R.S.Mullikan and C.C.J.Roothaan.
Proc. Nat. Acad. Sci. U.S.A., Vol. 45, No. 3, 394-8 (March, 1959).

Review of recent computational advances, particularly for multicentre integrals, and discussion of future possibilities.

J.Hawgood

539.19 : 537.523.74

8698. DISSOCIATION OF HYDROGEN IN A MICROWAVE DISCHARGE. T.M.Shaw.
J. chem. Phys., Vol. 30, No. 5, 1366-7 (May, 1959).

Dissociation cross-section for H_2 subject to 3000 Mc/s discharge is in agreement with previously reported d.c. and 5 Mc/s values.

A.E.D.Heylen

539.19 : 538.2

8699. MAGNETIC STUDY OF THE FROZEN PRODUCTS FROM THE NITROGEN MICROWAVE DISCHARGE. B.J.Fontana.
J. chem. Phys., Vol. 31, No. 1, 148-53 (July, 1959).

Magnetic susceptibility measurements were made during the condensation at low temperatures of the mixture of atomic and molecular nitrogen produced in a microwave discharge. From the nitrogen atom concentration in the gas reaching the condensing surface and the magnetic measurements on the deposited solid, it is concluded that a concentration of a few tenths of a mole percent N cannot be exceeded in the solid phase. Such concentrations are observed only for relatively brief intervals after which catastrophic recombination occurs. Stable, long-lived concentrations, which account for the previously reported thermal and light emission effects that accompany warmup of such deposits, are estimated to be less than a few hundredths of a mole percent N. Susceptibility measurements are based on calibration with solid molecular oxygen, and the calculation of N atom concentrations assumes that the susceptibility of dilute N atoms in an N_2 matrix approximates that of the free gas.

539.19

8700. DYNAMIC STABILITY OF FROZEN RADICALS.
I. DESCRIPTION AND APPLICATION OF THE MODEL.
J.L.Jackson.
J. chem. Phys., Vol. 31, No. 1, 154-7 (July, 1959).

The dynamic stability of a mixture containing free radicals is considered. On the basis of a simplified model a critical free radical concentration is estimated, such that any greater concentrations will be able to ignite spontaneously. For nitrogen atoms in a nitrogen molecule lattice this number is of the order of 0.3% under typical conditions.

539.19

8701. INTERFEROMETRIC MEASUREMENT IN THE SHOCK TUBE OF THE DISSOCIATION RATE OF OXYGEN. D.L.Matthews.
Phys. of Fluids, Vol. 2, No. 2, 170-8 (March-April, 1959).

The dissociation of oxygen was observed behind shock waves at Mach numbers of 8 to 10, over a temperature range of 3000°-5000° K. Photographs of the shocks were made using a Mach—Zehnder interferometer and a spark light source of effective duration 0.1 μsec. The velocity of the shock was measured using thin-film resistance thermometers to detect its passage. From this velocity and the state of the gas ahead of the shock, one can calculate the state of the gas behind the shock, both in the reaction zone and at equilibrium, from the interferometrically observed density ratios. Up to 12% equilibrium dissociation was obtained, following reaction zones of the order of 1 cm in length. The following rate constant, obtained from classical collision theory for the principal reaction

$$O_2 + O_2 \overset{kD}{\rightleftharpoons} 2O + O_2,$$

fitted the data well: $k_D = 7.4 \times 10^{11} PT^{1/2}(59\,380/T)^3 \exp(-59\,380/T)$ $cm^3\,mole^{-1}\,sec^{-1}$, where 59 380 is the known dissociation energy of oxygen, expressed in degrees Kelvin. The quantity P, the "collision efficiency", was adjusted to fit the data, and was found to be 0.07. The data are consistent with the results of several other investigators who used different methods. The recombination rate constant calculated from the dissociation rate constant is 8.4×10^{14} $cc^2\,mole^{-2}\,sec^{-1}$ at 3500°, and is approximately proportional to T^{-2}.

539.19

8702. ON A DERIVATION OF BADGER'S FORMULA.

A.I.Finkel'shteĭn.

Optika i Spektrosk., Vol. 3, No. 1, 82-4 (July, 1957). In Russian.

Varshni and Mitra (Abstr. 3877 of 1956) recently applied Badger's formula (1934) to a diatomic molecule. This formula can be stated as $k_e(r_e-d_{ij})^3 = C_{ij}$, where k_e and r_e are the equilibrium force constant and interatomic distance respectively, d_{ij} and C_{ij} are constants determined by the structure of electron clouds of atoms i and j. The author shows that it is not necessary to exclude attractive forces from a derivation of Badger's formula and finds a potential energy function for a diatomic molecule which is closer in shape to the experimental potential curves than the usual harmonic function.

A.Tybulewicz

539.19

8703. FORCE CONSTANT CALCULATIONS IN LINEAR TRIATOMIC MOLECULES FROM INFRARED AND MICROWAVE DATA.

P.H.Verdier and E.B.Wilson,Jr.

J. chem. Phys., Vol. 30, No. 5, 1372-3 (May, 1959).

The force constants obtained in calculations on COS and N_2O were very sensitive to the input data, particularly the distortion constant; this suggests that great care is needed in assessing such results.

J.Hawgood

539.19 : 621.373.1

8704. THE THEORY OF THE MOLECULAR OSCILLATOR AND ITS FLUCTUATIONS.

V.S.Troitskii.

Radiotekhnika i Elektronika, Vol. 3, No. 10, 1298-313 (Oct., 1958). In Russian.

The action of a non-linear oscillating system with one degree of freedom is analysed theoretically using a non-quantum mechanical approach based on a consideration of the dielectric constant of the excited gas. The frequency and amplitude fluctuation spectrum produced by the action of thermal noise in the oscillator tuned circuit and shot effect in the molecular beam is determined. It is shown that the latter does not affect the spectral line width.

R.C.Glass

539.19

8705. VIBRATIONAL TRANSITION PROBABILITIES FOR THE (8, 8) MATRIX OF THE CN ($A^2\Pi_i - X^2\Sigma^+$) BAND SYSTEM.

A.A.Wyller.

Astrophys. J., Vol. 127, No. 3, 763-74 (May, 1958).

Relative vibrational transition probabilities are calculated for eighty-one bands which belong to the red CN system. The vibrational wave-functions are constructed according to the phase-integral method applied by Wu to the case of diatomic molecules. A modification of the Morse potential function as suggested by Hulburt and Hirschfelder is used throughout. The transition probabilities agree quite well with the values of Fraser, Jarmain, and Nicholls, which are based upon approximations to the Morse wave-functions. This agreement is to be expected for the lower vibrational transitions, where there is little difference between the Morse potential and the Hulburt—Hirschfelder potential. The agreement is less satisfactory in the case of the theoretical values published by Bouigue. This corroborates previous experience that the approximation of Fraser et al to the Morse wave-functions is to be preferred. The values of the higher moments of the internuclear separation, $\int \psi_{v'} r^n \psi_{v''} dr$, depend in many cases more strongly than the overlap integrals on the precision of the potential models. The sets of r-centroids, $\int \psi_{v'} r \psi_{v''} dr / \int \psi_{v'} \psi_{v''} dr$, are evaluated for seventy-one bands, using the same dissociation potential for both potential functions. The Morse values are, in general, higher, in concordance with the consistent displacement to larger internuclear separations of the Morse potential function with respect to the Hulburt—Hirschfelder function for a given energy value. The Morse values published by Fraser et al agree well with the present ones.

539.19

8706. VIBRATIONAL RELAXATION OF DIATOMIC MOLECULES.

E.E.Nikitin.

Dokl. Akad. Nauk SSSR, Vol. 124, No. 5, 1085-8 (1959). In Russian.

The formulation of Landau and Teller (Abstr. 5214 of 1936) is applied to the investigation of the vibrational relaxation of the O_2 molecule in the reactions:

$$O_2^*(n) + N_2 \rightarrow O_2^*(n-1) + N_2$$

and

$$O_2^*(n') + ClO \rightarrow O_2^*(n'-1) + ClO.$$

J.W.Gardner

539.19

8707. MEAN AMPLITUDES OF VIBRATION IN ALLENE AND ALLENE-d_4 MOLECULES. II. APPROXIMATE CALCULATIONS FOR THE C—C DISTANCES.

S.J.Cyvin.

J. chem. Phys., Vol. 30, No. 1, 337 (Jan., 1959).

For Pt I see Abstr. 9086 (1958). Allene molecules may be treated approximately as linear symmetrical CY_2 where $Y = CH_2$ or CD_2. Mean amplitudes of vibration calculated in this way agree within 0.5-0.9% with more rigorous calculations.

R.C.Seymour

539.19

8708. ENERGIES AND VIBRATIONAL FREQUENCIES OF GASEOUS ALKALI HALIDE M_2X^+ IONS.

T.A.Milne and D.Cubicciotti.

J. chem. Phys., Vol. 30, No. 6, 1418-21 (June, 1959).

A potential function describing the interaction between the ions of M_2X^+ molecules is developed using a model suggested by Pauling. From this potential the energies and vibrational frequencies are calculated for these molecules. The harmonic contributions to the bending frequencies are shown to be far from negligible based on this purely ionic model. The entropy and free energy changes for the reaction $M(g)^+ + MX(g) \rightarrow M_2X^+(g)$ are considered.

539.19

8709. VIBRATIONAL RELAXATION TIMES IN OXYGEN.

M.Salkoff and E.Bauer.

J. chem. Phys., Vol. 30, No. 6, 1614-15 (June, 1959).

The vibrational relaxation time of oxygen is calculated and compared with experiment. Fairly good agreement is obtained with a Morse form for the O_2—O_2 intermolecular potential.

539.19

8710. VIBRATIONAL CONSTANTS OF THE WATER MOLECULE.

G.A.Khachkuruzov.

Optika i Spektrosk., Vol. 6, No. 4, 463-74 (April, 1959). In Russian.

Using the reported data on about 40 vibration levels of H_2O, the author calculated anew the values of 19 vibrational constants of H_2O, allowing for all anharmonicity constants of the second order. The author calculated also vibrational levels of H_2O which take part in triple resonance, frequencies of normal vibrations and anharmonicity constants.

A.Tybulewicz

539.19

8711. CALCULATION OF VIBRATIONAL FREQUENCIES IN LARGE MOLECULES. I. THEORETICAL.

H.L.McMurry.

J. molecular Spectrosc., Vol. 3, No. 3, 203-15 (June, 1959).

The secular equation for the vibration frequencies of large molecules is derived by considering such molecules to be assemblages of groups of atoms. This is useful because, particularly in hydrocarbons, intragroup vibrations within the groups are sometimes distinct from skeletal vibrations which are due mainly to translational and rotational motions of the groups regarded as more or less rigid units. The equations can be put in a form which reveals the terms tending to couple the intragroup vibrations of one group to those of others, and to couple the intragroup and skeletal modes. In this way it is possible to make simplifying approximations by intelligently selecting the small coupling terms. Even when coupling terms cannot be omitted some simplifications are possible because certain parts of the calculation are the same for any specific group regardless of its environment and can be used whenever the group is present in a molecule.

539.19

8712. CALCULATION OF VIBRATIONAL FREQUENCIES IN LARGE MOLECULES. II. APPLICATION TO ETHANE AND ETHANE-d_6.

H.L.McMurry.

J. molecular Spectrosc., Vol. 3, No. 3, 216-34 (June, 1959).

The theory of the preceding abstract for calculating the vibrational frequencies of molecules in terms of mixtures of vibrations within groups, and skeletal vibrations due to group rotations and translations, is applied to C_2H_6 and C_2D_6. It is shown that the matrix elements in the secular equation which reveal the couplings between the intragroup vibrations on the two CH_3 (or CD_3) groups can be neglected, as can the coupling between the intragroup vibrations on one CH_3 (or CD_3) and the rotational and translational displacements of the other. If these approximations are valid in other hydrocarbons the matrix elements for the couplings of the CH_3 (or CD_3) intragroup modes in C_2H_6 and C_2D_6 can be carried over without change to the larger hydrocarbons. When all couplings between intragroup and skeletal modes are neglected the results are still quite good, provided no approximations are made in the terms required for computing the skeletal frequencies.

539.19

8713. C–Cl STRETCHING FREQUENCIES AND THE MOLECULAR STRUCTURE OF POLYVINYL CHLORIDE.

T.Shimanouchi, S.Tsuchiya and S.Mizushima.
J. chem. Phys., Vol. 30, No. 5, 1365-6 (May, 1959).

The C–Cl stretching frequencies of polyvinyl chloride have been assigned. Evidence is given to show that the bands at 638 cm^{-1} and 603 cm^{-1} arise from vibrations in the crystalline state. The intensity ratio of the broad bands at 690 cm^{-1} and 615 cm^{-1} depends on the method of polymerization. The first of these arises from the C–Cl stretching vibration of the folded molecular form and the second from the vibration of the extended form. R.C.Seymour

539.19

8714. ANOMALOUS BAND INTENSITY IN FERMI RESONANCE.

R.N.Dixon.
J. chem. Phys., Vol. 31, No. 1, 258-60 (July, 1959).

When two vibrational levels of a molecule are in Fermi resonance there is a "sharing" of band intensity in transitions to these levels. It is shown that in exceptional cases Fermi resonance can result in an overtone or combination band being stronger than the fundamental with which it is in resonance. The theory is applied to the electronic spectrum of the NCO radical, in which such an anomaly exists.

539.19 : 535.343

8715. INTERNAL ROTATION AND INFRARED SPECTRA OF FORMIC ACID MONOMER AND NORMAL COORDINATE TREATMENT OF OUT-OF-PLANE VIBRATIONS OF MONOMER, DIMER, AND POLYMER.

T.Miyazawa and K.S.Pitzer.
J. chem. Phys., Vol. 30, No. 4, 1076-86 (April, 1959).

The infrared spectra of the four isotopic species of formic acid were measured in the vapour phase as well as in the solid nitrogen matrix in the region 400-800 cm^{-1}. Absorption bands in the vapour phase were analysed by considerations of band contours and comparisons with the frequencies distinctly observed in the matrix, and the previous assignment was revised. The torsional vibrations of the terminal OH groups of short-chain polymers of HCOOH were observed in the matrix at 685 and 694 cm^{-1}. The OH torsional frequencies of the trans isomer were located in the vapour phase at 582 (HCOOH), 576 (DCOOH), 450 (HCOOD), and 448 cm^{-1} (DCOOD). The energy difference between the two isomers was determined to be 2.0 ± 0.3 kcal/mole. The potential hindering internal rotation was calculated to be $2V$ (kcal/mole) $= 2._1(1-\cos\theta) + 9._9(1-\cos 2\theta) - 0._1(1-\cos 3\theta)$ from the energy difference and the fundamental torsional frequencies. The entropy of mixing of the two isomers was found to be 0.3 ± 0.1 cal deg^{-1} $mole^{-1}$ at 25°C. A normal coordinate treatment was made of the cis and trans isomers of monomer and of the dimer and polymer. The double bond characters calculated from the torsional potential constant agree with those calculated from bond lengths.

539.19

8716. A NOTE ON THE VALIDITY OF THE REVISED ROTATIONAL STRUCTURE CONSTANTS OF GREEN-YELLOW SYSTEM OF VO BANDS.

N.R.Tawde and N.Sreedhara Murthy.
Indian J. Phys., Vol. 31, No. 8, 391-4 (Aug., 1957).

The intensity distribution of the green-yellow system of VO bands and the transition probabilities studied in terms of the revised rotational structure constants reported by Lagerqvist and Selin (Abstr. 4517 of 1955) have proved the untenability of the old constants of Mahanti and the validity of the revised ones. This has been verified from the standpoint of asymmetry of molecules and internuclear separations in electronic states of the band systems of analogous oxides AlO, BO and TiO.

539.19

8717. CALCULATION OF ENERGY LEVELS FOR INTERNAL TORSION AND OVER-ALL ROTATION. III.

D.R.Herschbach.
J. chem. Phys., Vol. 31, No. 1, 91-108 (July, 1959).

For Pt II, see Abstr. 8045 (1957). A general treatment of hindered internal rotation is given for molecules that can be regarded as a rigid symmetric top attached to a rigid frame which may be completely asymmetric. The perturbation approach developed in previous papers is simplified and extended by use of a method which relates the perturbation coefficients to the exact energy levels obtainable for the limiting case of two coaxial symmetric tops. Tables are given which provide the torsional energy levels and the perturbation coefficients through fourth order in the coupling between internal and over-all rotation. The tables apply to the lowest three groups of torsional states for a potential barrier of the form

$$V(\alpha) = \tfrac{1}{2}V_N(1 - \cos N\alpha) + \tfrac{1}{2}V_{2N}(1 - \cos 2N\alpha),$$

where the periodicity N is arbitrary and $0 \lessapprox V_{2N}/V_N < 5\%$. The range of validity of the approximations is examined, and it is concluded that in most applications the previous second order tratment yields reliable values of the barrier height. Situations in which higher order corrections affect microwave spectra are illustrated by a reanalysis of the data for methyl silane and acetaldehyde.

539.19 : 535.333

ELECTRONIC QUENCHING OF $OH(^2\Sigma^+)$ IN FLAMES AND ITS SIGNIFICANCE IN THE INTERPRETATION OF ROTATIONAL RELAXATION. See Abstr. 7944

539.19

8718. A $^6\Sigma$-$^6\Sigma$ TRANSITION IN CrH.

B.Kleman and U.Uhler.
Canad. J. Phys., Vol. 37, No. 5, 537-49 (May, 1959).

The infrared band system of CrH has been photographed at high dispersion. Rotational analyses of the 0–0 and 0–1 bands are given. The transition is shown to be a $^6\Sigma^+$-$^6\Sigma^+$. The upper $^6\Sigma$-state shows an extended perturbation. Rotational and vibrational constants for the two states are given. The application of theoretical expressions for the fine structure splitting in $^6\Sigma$-states is discussed, and approximate values of the splitting constants in the observed states have been derived. The corresponding system of the isotope molecule CrD was also photographed and a vibrational analysis has been carried out. Finally the electronic configurations of the molecular states and the nature of the perturbing state are discussed. The ultraviolet systems of CrH are briefly mentioned.

539.19 : 535.343

8719. TRAPPED NH_2 RADICALS AT 4.2° K.

G.W.Robinson and M.McCarty, Jr.
J. chem. Phys., Vol. 30, No. 4, 999-1005 (April, 1959).

A study was made of the electronic absorption spectrum of the NH_2 radical trapped in an argon matrix on a liquid helium cooled surface. The radical was produced in a microwave discharge of argon mixed with a small amount of parent molecule, ammonia or hydrazine. The long effective absorbing path is illustrated by the presence of new bands of NH_2, too weak to have yet been observed in the flash photolysis spectrum. That the radicals have also been found in moderate concentration from low-pressure discharges containing hydrogen and nitrogen in many forms indicates that they are easily built up from smaller fragments, a fact which may be important in the explanation of the origin of these radicals in comets The radical is positively identified by the excellent correlation betwe the low temperature spectrum and the gas-phase spectrum recently analysed by Ramsay, and in agreement with this analysis only alternate bands appear strongly at 4.2° K. The observed features, which represent rotational lines of the electronic transition, surprisingly enough, are less than 3 cm^{-1} wide, the lack of broadening indicating that the radicals are situated in equivalent matrix sites, possibly in an ordered argon crystal lattice, and evidence is presented which shows that NH_2 experiences nearly free end-over-end rotation in the matrix. The experimentally observed small population of the lowest state of para-NH_2 shows a breakdown of the usual $s \leftrightarrow a$ selection rule for exchange of identical nuclei. A determination from relative intensity measurements of interaction constants for Fermi resonanc between certain $0\nu_2'0$ and $1(\nu_2'-4)0$ levels shows that the intensity of the latter is caused primarily by the resonance and not by the Franck–Condon effect.

539.19

8720. THE METASTABLE STATE OF DYE MOLECULES.

A.Jabłoński.
Bull. Acad. Polon. Sci. Ser. Sci. math. astron. phys., Vol. 6, No. 9, 589-93 (1958).

A new hypothesis concerning the nature of the M metastable state of luminescent molecules of plane conjugated systems is proposed. Energy levels of fluorescein and trypaflavine molecules are calculated from the equations deduced. G.I.W.Llewely

539.1

8721. OPEN-SHELL GROUND-STATE ENERGY OF THE He_2^+ MOLECULE ION.

P.Csavinszky.
J. chem. Phys., Vol. 31, No. 1, 178-81 (July, 1959).

"Open-shell" calculations have been made for the He_2^+ molecu ion. Two different three-parameter wave-functions have been tried and the results are compared with "closed-shell" calculations of other authors.

539.19

722. THE LOWER EXCITED STATES AND THE HOSPHORESCENT STATE OF DIPHENYL. I. K.Iguchi.
. Phys. Soc. Japan, Vol. 12, No. 11, 1250-5 (Nov., 1957).

The lower excited π electronic states of diphenyl were calcu- ated, employing Pariser's approximation and assuming empirical alues for the atomic Coulomb integrals: $(11|11) = 10.959$ eV, $1|22) = 6.895$ eV, $(44|55) = 6.546$ eV. The B_{3u} state was obtained or the lowest excited singlet, against the B_{2u} state obtained by ondon where the products of wave-functions for the benzene olecule were utilized. A method of testing the phenomena of hosphorescence is suggested and the group theoretical classifi- ation of combination by L-S interaction is discussed.

539.19

723. EXCITATION ENERGY TRANSFER FROM DYE OLECULES IN THE METASTABLE STATE.
.Bauer, A.Bączyński and M.Czajkowski.
ull. Acad. Polon. Sci. Ser. Sci. math. astron. phys., Vol. 6, No. 10, 53-8 (1958).

The dependence of the degree of polarization of fluorescence d phosphorescence on the concentration has been determined for cridine yellow in boric acid. Energy transfer from molecules in e M metastable state is shown to occur. G.I.W.Llewelyn

539.19 : 539.2

724. ORIGIN OF ZERO-FIELD SPLITTINGS IN TRIPLET TATES OF AROMATIC HYDROCARBONS.
.Gouterman and W.Moffitt.
. chem. Phys., Vol. 30, No. 4, 1107-8 (April, 1959).

The triple degeneracy of the phosphorescent state of naphthalene already removed in the absence of external field for naphthalene isomorphous substitution in crystals of durene. This splitting is ttributed to pure spin—spin interactions, the crystalline field ffect and spin—orbit coupling playing negligible parts. The effect f spin—spin interaction is considered in detail for the prototype thylene with a planar configuration. The splitting arises from rst order anisotropies in the electronic correlations. A similar rigin occurs for the microwave absorption of oxygen.
G.F.J.Garlick

539.19

725. RING-SHAPED ELECTRON GAS MODEL FOR THE ESCRIPTION OF π-ELECTRON STATES IN AROMATIC HYDRO- ARBONS. H.Baur.
. Naturforsch., Vol. 13a, No. 12, 1057-66 (Dec., 1958). In German.

The stationary states of π-electrons in aromatic hydrocarbons re described in terms of a ring-shaped model of the electron gas, hich permits calculation of the type of binding of the π-electrons. he Hückel resonance energy appears as a Coulombic exchange nergy of the π-electrons among themselves. The model may be pplied to the cases of poly-acenes and poly-phenes.
R.C.Seymour

539.19 : 535.343

726. ON THE ELECTRONIC SPECTRA OF PORPHINE.
.Kobayashi.
. chem. Phys., Vol. 30, No. 5, 1362-3 (May, 1959).

The lowest excitation energies of the prototype porphine have een calculated from the semi-empirical method of S.C.F.-M.O. heory, and an energy level diagram is drawn from these values.
R.D.Hudson

539.19

727. ON THE ELECTRONIC STRUCTURE OF PORPHINE.
.Kobayashi.
chem. Phys., Vol. 30, No. 5, 1373-4 (May, 1959).

Theoretical. The electronegativity parameter of an N atom is elated in a self-consistent way to the π-electron density, in an C.F.-L.C.A.O. treatment with simple approximations.
J.Hawgood

539.19

728. ELECTRONIC STRUCTURE OF THIOTHIOPHTEN.
.Giacometti and G.Rigatti.
. chem. Phys., Vol. 30, No. 6, 1633-4 (June, 1959).

Thiothiophten is an aromatic-like molecule containing three lphur atoms and is unusual in having superimposed σ and π systems nonlocalized electrons. From electronic and steric considerations is concluded that structures of this type can be stabilized with ry small distortions from normal valence angles.
G.I.W.Llewelyn

539.19

8729. THE ELECTRONIC STRUCTURE OF HYDROGEN FLUORIDE. R.A.Ballinger.
Molecular Phys., Vol. 2, No. 2, 139-57 (April, 1959).

Self-consistent field (SCF) calculations were carried out at the experimental internuclear distance using a single determinantal wave-function composed of molecular orbitals (MO's) expressed as linear combinations of atomic orbitals (LCAO's). The AO's used are of Slater-type in which the parameters have been varied within the framework of the variational method. The improvement in the energy and other physical quantities brought about by the variation of the Slater parameters is discussed in relation to the results of other methods of obtaining improved wave-functions for this molecule.

539.19

8730. LCAO-MO TREATMENT OF PHTHALOCYANINE
A.Chikayama, Y.Ooshika, R.Itoh and I.Oshida.
J. Phys. Soc. Japan, Vol. 12, No. 11, 1316 (Nov., 1957).

539.19 : 539.18

EFFECT OF THE CORE ON TRANSITIONS OF OPTICAL ELECTRONS. See Abstr. 8681

539.19

8731. THEORY OF ANISOTROPIC HYPERFINE INTERACTIONS IN π-ELECTRON RADICALS. H.M.McConnell and J.Strathdee.
Molecular Phys., Vol. 2, No. 2, 129-38 (April, 1959).

Anisotropic proton hyperfine interactions in π-electron radicals are approximated by a magnetic dipole interaction between each proton and an electron spin magnetization that is distributed in 2s and 2p Slater atomic orbitals centred on carbon atoms.

539.19

8732. QUADRUPOLE COUPLING CONSTANT, DIPOLE MOMENT, AND ELECTRON POPULATION OF CO. B.J.Ransil.
J. chem. Phys., Vol. 30, No. 4, 1113-14 (April, 1959).

Improvement of the LCAO-MO-SCAF calculation for CO by inclusion of the Is orbitals and by better atomic population deter- minations gives dipole moment values in good agreement with experiment. G.I.W.Llewelyn

539.19

8733. NUCLEAR QUADRUPOLE COUPLING IN THE ALKALI CHLOROIODIDES. II. IODINE RESONANCES.
R.S.Yamasaki and C.D.Cornwell.
J. chem. Phys., Vol. 30, No. 5, 1265-71 (May, 1959).

For Pt I, see Abstr. 2619 (1958). Frequencies are reported for $m = \pm\frac{1}{2}\rightarrow\pm\frac{3}{2}$ transitions of I^{127} nuclei in polycrystalline samples at 25°C of $CsICl_2$, $RbICl_2$, $KICl_2$, $KICl_2\cdot H_2O$, $CsICl_4$, $RbICl_4$, $KICl_4$, $KICl_4\cdot H_2O$, $NaICl_4\cdot 2H_2O$. The coaxial cavity super-regenerative oscillator (250-610 Mc/s) used for these measurements is described. The average quadrupole coupling constants are −3110 Mc/s for ICl_2^- and +3090 Mc/s for ICl_4^-. These values are shown to be entirely consistent with resonance hybrid structures which had been selected previously for the discussion of the chlorine resonance data. The coupling constants are used to estimate electron populations for valence orbitals of I and Cl, and, with certain assumptions, to find approximate MO's of LCAO form for the bonding electrons. The conclusion reached is that the attainment by iodine of higher valences in these ions is due more to transfer of charge to chlorine atoms than to promotion to higher orbitals of iodine. It appears that most of the covalent binding present arises from an MO in which an iodine p orbital is associated with a symmetry orbital made up of collinear sp hybrid orbitals of two attached chlorine atoms.

539.19

8734. THE QUANTUM-MECHANICAL CALCULATION OF ONE- ELECTRON PROPERTIES. II. ONE- AND TWO-CENTER MOMENT INTEGRALS. A.Kuppermann, M.Karplus and L.M.Isaacson.
Z. Naturforsch., Vol. 14a, No. 4, 311-18 (April, 1959).

For Pt I, see Abstr. 1815 (1959). Two-centre moment integrals for Slater-type atomic orbitals are explicitly expressed in terms of a general formula involving the three quantum numbers and the effective nuclear charge of each of the two orbitals, the internuclear distance, and the usual A and B functions. A corresponding expres- sion for one-centre moment integrals is also given. The use of the one- and two-centre moment integral formulae in digital computer calculations is discussed.

539.19

8735. ONE-CENTER MOLECULAR ORBITAL WAVE FUNCTION FOR METHANE. S.Koide, H.Sekiyama and T.Nagashima.
J. Phys. Soc. Japan, Vol. 12, No. 9, 1016-21 (Sept., 1957).

The validity of the spherical approximation for the potential due to nuclei used in the calculation of molecules with good symmetry by means of the one-centre MO method is examined for the methane molecule. Molecular orbital wave-functions are set up as harmonic expansion about the central carbon nucleus, and energy expectation values are calculated with respect to the exact Hamiltonian. Results obtained by using various approximations are compared. It is shown that while the effect of the angular dependent part of the nuclear potential on the energy value is not so large as is expected, the electron charge distribution has fairly large directional dependence caused by the non-central part of the potential.

539.19

8736. SOME TWO-CENTRE INTEGRALS FOR THE CALCULATION OF A MOLECULAR ORBITAL ON THE BASIS OF A CORRELATION FACTOR. F.Berencz.
Acta phys. Hungar., Vol. 9, No. 4, 381-92 (1959). In German.

Tables of values for the two centre integrals I^{n}_{iklm} and J^{n}_{iklm}, for which analytical expressions were given in an earlier paper. (Abstr. 6390 of 1957). R.C.Seymour

539.19

8737. CONFIGURATION INTERACTION IN THE LITHIUM HYDRIDE MOLECULE. I. A DETERMINANTAL AO APPROACH. A.M.Karo and A.R.Olson.
J. chem. Phys., Vol. 30, No. 5, 1232-40 (May, 1959).

Numerical Hartree—Fock lithium orbitals and a 1s exponential hydrogen orbital have been used as basis functions for determining eigenfunctions for the LiH molecule. The calculations were carried out for both the ground electronic state and the first excited electronic state at nine internuclear distances. A configuration interaction treatment was superimposed on the valence-bond, ground-state calculation. Determinantal functions were constructed for the states of the system, the Hamiltonian matrix calculated between these states, and the corresponding secular determinant solved for the eigenvalues and corresponding eigenvectors. The total molecular energy, binding energy, and dipole moment were determined as functions of the internuclear distance. Where possible, comparison is made with experiment and with other theoretical work.

539.19

8738. CONFIGURATION INTERACTION IN THE LITHIUM HYDRIDE MOLECULE. II. AN SCF LCAO-MO APPROACH. A.M.Karo.
J. chem. Phys., Vol. 30, No. 5, 1241-5 (May, 1959).

Numerical Hartree—Fock lithium orbitals and a 1s exponential hydrogen orbital have been used as basis functions for a self-consistent field molecular orbital calculation of the electronic structure of the LiH molecule. The molecular orbitals were approximated as linear combinations of the atomic orbitals. Calculations were carried out at nine internuclear distances for both the ground state and the first excited state. Configuration interaction was included with the restriction that the 1σ molecular orbital remains filled.

539.19

8739. ELECTRON POPULATION ANALYSIS OF LiH AND HF. A.M.Karo.
J. chem. Phys., Vol. 31, No. 1, 182-92 (July, 1959).

Following the analysis proposed by Mulliken (1955), SCF LCAO-MO coefficients for LiH and HF are used to obtain qualitative information about the electron distributions in these molecules. Several additional aspects of population analysis are considered: the variation of atomic and overlap populations with internuclear distance and with choice of basis atomic orbitals, and the extent to which CI alters the qualitative description. It is shown that at equilibrium distances the results appear to be qualitatively unchanged by CI but are rather sensitive to the choice of basis functions.

539.19

8740. APPROXIMATE NATURAL SPIN ORBITALS FOR THE HYDROGEN MOLECULE. M.A.Eliason and J.O.Hirschfelder.
J. chem. Phys., Vol. 30, No. 6, 1397-404 (June, 1959).

Approximate natural spin orbitals and the corresponding occupation numbers are obtained over a wide range of internuclear separations for the ${}^1\Sigma_g{}^+$ ground state and the ${}^3\Sigma_u{}^+$ excited state of the hydrogen molecule, using the Hirschfelder—Linnett wave-functions. The resulting natural expansions and their variation with internuclear separation are then discussed in terms of electronic configurations.

539.19

8741. NATURAL SPIN ORBITAL ANALYSIS OF HYDROGEN MOLECULE WAVE FUNCTIONS. H.Shull.
J. chem. Phys., Vol. 30, No. 6, 1405-13 (June, 1959).

Approximate wave-functions for the hydrogen molecule ground state previously available in the literature are analysed quantitatively into approximate natural spin orbital functions with particular attention to the corresponding occupation numbers. The analysis demonstrates the very great similarity of all such trial wave-functions, and especially the largely molecular orbital nature of the wave-function. In addition it shows a close relationship between the molecular orbital and valence bond functions, and the importance of allowing for angular correlation of the electrons by including terms dependent upon the azimuthal coordinate. The analysis particularly demonstrates that approximate natural spin orbital occupation numbers are nearly invariant under a wide variety of choices of basis functions, and therefore are particularly suitable for comparison of different approximate functions and for discussion of their respective properties.

539.19

8742. ACCEPTOR PROPERTIES, REORGANIZATION ENERGIES, AND π BONDING IN THE BORON AND ALUMINUM HALIDES. F.A.Cotton and J.R.Leto.
J. chem. Phys., Vol. 30, No. 4, 993-8 (April, 1959).

Simple MO theory was used to estimate the strength of π-bonding in the planar, monomeric boron and aluminium halide molecules by partitioning the total energy of dissociation to valence state atoms according to relative values of σ and π overlaps. These π-bond energies were used to determine the energies required to reorganize the planar molecules to the pyramidal forms existing in their adducts with Lewis bases, and the effects of these reorganization energies on the relative over-all acceptor strengths of the halides is discussed. A number of independent checks indicate that the calculated energies are reasonable.

539.19

8743. A SEMI-EMPIRICAL THEORY OF THE CONJUGATED SYSTEMS. I. GENERAL FORMULATION. Y.Ooshika.
J. Phys. Soc. Japan, Vol. 12, No. 11, 1238-45 (Nov., 1957).

A general semi-empirical theory of conjugated double bond systems, including those with non closed-shell structures and heteroatoms, is developed. The general formulation is similar to that of Pariser and Parr and that of Pople and others, but for non-closed-shell structures the equations are somewhat different from those of Pople et al. The necessary parameters for hydrocarbons, which have previously been determined arbitrarily, are estimated by using experimental data on the ethane and ethylene molecules. The theory is checked by some simple examples and found to be in satisfactory agreement with experiments.

539.19

8744. A SEMI-EMPIRICAL THEORY OF THE CONJUGATED SYSTEMS. II. BOND ALTERNATION IN CONJUGATED CHAINS. Y.Ooshika.
J. Phys. Soc. Japan, Vol. 12, No. 11, 1246-50 (Nov., 1957).

For Pt I, see preceding abstract. The problem of the convergence of the absorption wavelengths of chain-conjugated systems, polyenes, and merocyanines, is discussed, by using the method developed in Pt I. It is shown that the bond alternation as the cause of the convergence of the absorption wavelengths, which has been presumed from the view of the resonance theory but cannot be deduced in terms of the ordinary molecular orbital theory, do actually occur even for an infinite polyene chain, but the calculated limiting wavelength does not agree with the experiment quantitatively, possibly because of the Coulomb attraction between the excited electron and the hole.

539.19

8745. NATURE OF THE HYDROGEN BOND. L.Paoloni.
J. chem. Phys., Vol. 30, No. 4, 1045-58 (April, 1959).

Starting from a molecular orbital viewpoint, a general descriptio is given of hydrogen bonds X—H···Y. The case of weak hydrogen bonds, as in associated liquids, is developed in detail, with the O—H···O bond as an example. The new feature in the treatment is the introduction of excited 2s and 2p orbitals of the hydrogen atom.

the consequences of which, it is shown, provide a satisfactory account of the effects of hydrogen bonding both on the X—H stretching infrared band and on dipole moments. The energy change accompanying hydrogen bond formation is considered as depending on the nature of the hybridization of the atomic orbitals involved. Again it is found that the experimental pattern is reproduced when the 2s and 2p orbitals of hydrogen are included. Moreover the behaviour of the energy as a function of the hybridization parameters suggests a way in which the changes in the X—H bond and in the atom Y can account for the various properties observed in molecular associations due to hydrogen bonding.

539.19

8746. THE HYDROGEN BOND. L.E.Orgel.
Rev. mod. Phys., Vol. 31, No. 1, 100-2 (Jan., 1959).

A summary of present knowledge of hydrogen bonds, with particular reference to configurations of biological interest. J.Iball

539.19

8747. STUDY ON THE HYDROGEN BOND IN NH_4HF_2 BY NMR.
T.Sidei and S.Yano.
J. chem. Phys., Vol. 30, No. 4, 1109-10 (April, 1959).

The position of the hydrogen in the $F—H\cdots F$ bond in NH_4HF_2 is determined for a model of double minima potential. A probable value of 0.074A is deduced for the deviation parameter. G.I.W.Llewelyn

539.19

8748. HYDROGEN BONDED SPECIES IN ALCOHOLS.
M.Saunders and J.B.Hyne.
J. chem. Phys., Vol. 31, No. 1, 270 (July, 1959).

See Abstr. 6199 of 1959. Answering an objection that N.M.R. data for t-butanol/CCl_4 could not be fitted, with the experimental accuracy, to theoretical curves for a simple monomer—trimer equilibrium. Although, as the concentration is lowered, the trimer dissociates more rapidly than the dimer, at the lowest concentration at present accessible, the trimer can be shown to be still responsible for all, or some, of the observed slope. The monomer—trimer model accounts for the present data in t-butanol and phenol—CCl_4 solutions. R.C.Murray

539.19

8749. BONDING OF THE N_2 MOLECULE ON THE BASIS OF STATISTICAL THEORY. P.Gombás.
Z. Phys., Vol. 152, No. 4, 397-401 (1958). In German.

It is shown that, if the Weizsäcker correction for the atomic interaction energy is allowed for in the statistical theory of the atom, a bond can be expected in the case of homopolar molecules. According to provisional calculations carried out for the N_2 molecule, a bonding energy of 20 eV is obtained for the empirical nuclear distance. F.Lachman

539.19

8750. STATISTICAL TREATMENT OF THE N_2 MOLECULE.
P.Gombas.
Acta phys. Hungar., Vol. 9, No. 4, 461-9 (1959). In German.

In terms of the statistical theory of atoms in homopolar molecules the binding in the N_2 molecule can be explained by considering the Weizäcker kinetic energy contribution to the exchange energy of the N atoms. Assuming simple superposition of the electron clouds the internuclear distance obtained is 1.39 A and the binding energy 10.9 eV. The discrepancy in internuclear distance could be decreased by using higher order approximations. R.C.Seymour

539.19 : 539.213

8751. STRUCTURE OF VITREOUS $B_2O_3\cdot\frac{1}{3}H_2O$.
M.E.Milberg and F.Meller.
J. chem. Phys., Vol. 31, No. 1, 126-9 (July, 1959).

A boron oxide glass containing 25 mole per cent water, corresponding to the formula $B_2O_3\cdot\frac{1}{3}H_2O$, was prepared and its structure studied. Diffractometric X-ray scattering measurements were made for both vitreous $B_2O_3\cdot\frac{1}{3}H_2O$ and vitreous B_2O_3, and from these measurements radial distribution functions were computed. Examination of the atomic distribution function of $B_2O_3\cdot\frac{1}{3}H_2O$ and comparison of the electronic distribution functions of $B_2O_3\cdot\frac{1}{3}H_2O$ and B_2O_3 indicate that the fundamental triangular coordination of vitreous B_2O_3 is retained in $B_2O_3\cdot\frac{1}{3}H_2O$, but the network of the latter is somewhat looser than that of the former. It is suggested that while most of the oxygen atoms are shared between boron atoms, some of the oxygens are present in hydroxyl groups or O—H—O hydrogen bonds. The possibility that a small fraction of the boron atoms are coordinated by four oxygen atoms is not completely excluded.

539.19

8752. ON CONDITIONS FOR THE JOINING OF FUNCTIONS IN A UNI-DIMENSIONAL METALLIC MODEL OF A MOLECULE.
L.A.Borovinski.
Optika i Spektrosk., Vol. 4, No. 4, 526-8 (April, 1958). In Russian.
English summary : PB141047T-9, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

Consideration of two free-electron models of the benzyl radical shows that neither the usual joining conditions nor Kuhn's modified conditions are satisfactory. The first model is one-dimensional, a circle with a linear tail, and the second is two-dimensional, an annular region bounded by two concentric circles, with a tail bounded by two radii and an arc of another concentric circle. It is found that the coupling between the electrons in the ring and in the tail is weak. J.Hawgood

539.19

8753. QUANTUM THEORY OF DIELECTRIC ORIENTATION-POLARIZATION OF GASES. I. THE STATIC ORIENTATION-POLARIZATION OF A DIPOLE-GAS CONSISTING OF SYMMETRICAL TOP MOLECULES. W.Maier and H.K.Wimmel.
Z. Phys., Vol. 153, No. 3, 297-313 (1958). In German.

This part deals with static polarization only, frequency dependence is treated in Pt II. The polarization consists of two parts. The first is determined by the non-diagonal matrix elements of the permanent dipole moment, the second by the diagonal elements. For the latter a term "versation-polarization" is coined for processes, analogous to Umklapp-processes, where molecules jump from one allowed orientation to another on collision. Partition functions taking into account statistical weights of rotational levels as determined by nuclear spins, and molecular symmetries are calculated by means of asymptotic expansions. The two parts of the polarization are calculated for symmetrical top molecules. H.Motz

539.19

8754. QUANTUM THEORY OF DIELECTRIC ORIENTATION-POLARIZATION OF GASES. II. THE ORIENTATION-POLARIZATION OF A DIPOLE GAS CONSISTING OF SYMMETRICAL TOP MOLECULES IN AN OSCILLATING ELECTRIC FIELD.
W.Maier and H.K.Wimmel.
Z. Phys., Vol. 154, No. 2, 133-49 (1959). In German.

This is a continuation of the preceding abstract and considers frequency dependence. It is shown that the "versation-polarization" has the character of a relaxation process while the rotation polarization proper has a line spectrum. The ratio of the two polarizations depends on that of the two principal moments of inertia. The relation of versation and inversion polarization is examined and it is concluded that the non-resonant part of the dielectric polarization is a "versation" rather than an inversion effect. H.Motz

539.19

8755. ON THE IDENTITY OF THE GREEN FORMS OF BIANTHRONE. E.Wasserman and R.E.Davis.
J. chem. Phys., Vol. 30, No. 5, 1367 (May, 1959).

The kinetics of the transformation of the green forms of dehydrobianthrone to the yellow form have been determined. It is concluded from the absorption spectra that the green thermochromic and photochromic forms are identical with the yellow form. G.I.W.Llewelyn

539.19

8756. ELECTRONIC STRUCTURE OF SOME GROUP III HALIDES FROM PURE QUADRUPOLE RESONANCE MEASUREMENTS.
P.A.Casabella, P.J.Bray and R.G.Barnes.
J. chem. Phys., Vol. 30, No. 6, 1393-6 (June, 1959).

The Al^{27} pure quadrupole resonances in $AlBr_3$ are reported. With the addition of these data, the quadrupole coupling constants of all the atoms in the structure of five group III halides are known. For these cases it has been possible to determine complete self-consistent electron distributions for the molecules. In addition, for two of the compounds it has been possible to determine bond angles and establish the existence of bent bonds in the molecules.

539.19 : 532.77

8757. STRUCTURE OF SILICO-TUNGSTIC ACID IN AQUEOUS SOLUTION. H.A.Levy, P.A.Agron and M.D.Danford.
J. chem. Phys., Vol. 30, No. 6, 1486-8 (June, 1959).

The structure of 12-silico-tungstic acid, $H_4SiW_{12}O_{40}$, in aqueous solution has been investigated by X-ray diffraction. The results indicate that 12 tungsten atoms are in a monodisperse species with arrangement similar to that found in the crystalline acid. Each tungsten atom has two near tungsten neighbours at each of the distances 3.36 A and 3.71 A.

539.19

8758. PREDICTION OF THE SHAPES OF TWO-CENTERED COVALENT MOLECULES AND IONS. A.E.Parsons and A.W.Searcy.
J. chem. Phys., Vol. 30, No. 6, 1635-6 (June, 1959).

The electrostatic model of Searcy (Abstr. 754 of 1959) for the prediction of the shapes of covalent molecules is extended by two approaches to apply to two-centred systems. G.I.W.Llewelyn

539.19

8759. DIPOLE MOMENT FUNCTION OF DIATOMIC MOLECULES. J.Trischka and H.Salwen.
J. chem. Phys., Vol. 31, No. 1, 218-25 (July, 1959).

The connection between the dipole moment function (dipole moment as a function of internuclear distance), M(u), and its matrix elements has been studied for the one-dimensional model of a diatomic molecule. It is shown that M(u) is completely determined by a single row or column of the matrix $\langle v|M(u)|v'\rangle$, but that the diagonal matrix elements do not completely determine M(u). Attention is given to the problem of approximating M(u) when a finite number of matrix elements are known. The usual method (called by us the "polynomial approximation") is compared with a new approximation scheme which we call the "wave function approximation". These methods are equivalent for a harmonic oscillator, but not in general. Estimates of the errors of the two methods are obtained in the case where the anharmonicity of the potential is small. The "wave-function expansion" of M(u) which is developed and used to carry out the calculations is a new way of relating matrix elements to M(u) which makes it much easier to calculate the dipole moment function from its matrix elements. This method has been used to obtain explicit formulae relating the dipole moment function to its matrix elements for the harmonic oscillator and for the Morse oscillator.

539.19

8760. ON SOLVENT EFFECTS IN DIPOLE MOMENT DETERMINATIONS. K.Shogenji.
J. Phys. Soc. Japan, Vol. 13, No. 2, 160-6 (Feb., 1958).

A new theory is presented in which the solute molecule is assumed to have a spheroidal form and have an electric dipole moment directed in the axis of rotation at its centre. The cavity field and the reaction field, etc. are calculated as the functions of the shape of the solute molecule and the dielectric constant of the solvent, and the molecular polarization is also calculated. A theoretical curve, expressing the molecular polarization v. the dielectric constant of the solvent, obtained from this theory shows a fairly good agreement with the experimental results. The curve shows that the molecular polarization has a maximum value for a small dielectric constant of the solvent and its value decreases for larger dielectric constants.

539.19

8761. DIPOLE MOMENT OF TETRABORANE.
J.R.Weaver, C.W.Heitsch and R.W.Parry.
J. chem. Phys., Vol. 30, No. 4, 1075-6 (April, 1959).

The dipole moment of tetraborane, as measured in benzene solution by a heterodyne beat method, is 0.56 ± 0.1.

539.19

8762. ON THE RELATION BETWEEN BOND LENGTH AND HYBRIDIZATION. THE CONSTITUTION OF SULPHUR NITRIDE.
I.Lindqvist.
J. Inorg. nuclear Chem., Vol. 6, 159-60 (1958).

539.19

8763. PREDICTION OF ISOMERIC FORM AND BOND ANGLES FOR COVALENT MOLECULES AND IONS. A.W.Searcy.
J. chem. Phys., Vol. 31, No. 1, 1-4 (July, 1959).

An electrostatic model for prediction of bond angles in covalent molecules is extended to molecules and ions whose central atoms are surrounded by five or six valence electron pairs of which at least one pair is a lone pair. The stable isomers are the isomers which provide the lone pair electrons with the maximum possible cone of space adjacent to the central atom. Angular deflections fro symmetrical coordination positions in these molecules are in the directions predicted by the model, but the observed deflections are usually less than those expected on the basis of behaviour in simple molecules.

539.19 : 535.34

MOLECULAR STRUCTURE OF VINYL FLUORIDE.
See Abstr. 7967

539.19 : 536.23

8764. FORCE CONSTANTS FOR LIKE MOLECULES ON EXP-SI MODEL FROM THERMAL CONDUCTIVITY. K.P.Srivastava.
Indian J. Phys., Vol. 31, No. 8, 404-14 (Aug., 1957).

The Chapman–Enskog theory of non-uniform gases was utilized in determining the force parameters for some simple non-polar molecules on the exp-six model from the observed variation of thermal conductivity with temperature. The method used is an adaptation of the Keesom and the Lennard-Jones procedures and has been applied to neon, argon, krypton and xenon. First the parameter α is fixed up and then translations are carried out to determine the parameters ϵ/k and r_m. To test the adequacy of the model, both the equilibrium and non-equilibrium properties of gases have been computed by utilizing these experimentally determined potential parameters, and the results compared with the observed values over an extensive range of temperatures. The agreement between theory and experiment is found to be quite satisfactory, showing thereby the adequacy of the exp-six model and the appropriateness of the potential parameters used.

539.19

8765. GENERAL COLLISION THEORY TREATMENT FOR THE RATE OF BIMOLECULAR, GAS PHASE REACTIONS.
M.A.Eliason and J.O.Hirschfelder.
J. chem. Phys., Vol. 30, No. 6, 1426-36 (June, 1959).

A collisional approach, somewhat similar to the Wang-Chang and Uhlenbeck treatment for the transport properties of polyatomic molecules, is used to obtain a general expression for the rate of a bimolecular chemical reaction in terms of reaction cross-sections. Specialization is then made to the case where a Maxwell–Boltzman velocity distribution may be assumed for the reactants. This leads to a Laplace transform relation between the rate constants for reaction of molecules in definite internal quantum states and the reaction cross-sections. The further assumption of a Boltzmann distribution among the internal energy states of the reactant molecules then leads to a rate equation of the usual form and to an explicit expression for the single overall rate constant. This expression is used to re-derive the results of the old "simple" collision theories. Finally, a collisional approach is used to re-derive the usual rate expression of the Eyring theory of absolute reaction rates. The rather drastic approximations which seem to be necessary for such a derivation are pointed out and discussed.

539.1

8766. CALCULATION OF THE ENERGIES OF SOME ALKALI HALIDE TRIMERS. T.A.Milne and D.Cubicciotti.
J. chem. Phys., Vol. 30, No. 6, 1625-6 (June, 1959).

Minimum energies and corresponding interatomic distances have been determined for a series of eleven alkali halide trimers, assuming a six-membered planar ring structure. G.I.W.Llewel

539.1

8767. POLYMERS AND THEORY OF NUMBERS. IV. THE PROBLEM OF WEAK AND STRONG LINKS IN DEGRADATION.
R.K.Pathria and V.S.Nanda.
J. chem. Phys., Vol. 30, No. 5, 1322-7 (May, 1959).

For Pt III, see Abstr. 6221 of 1959. The technique employed in earlier work is extended to treat the degradation of a monodisperse polymer system consisting of N chains such that each chain has two types of link of unequal strength, distributed rando over its length. An expression for the size distribution in the degraded material is obtained in a closed form which is convenient for numerical computations. Further, the weight average chain length is expressed exactly in the form of a definite integral from which the particular cases follow in a straightforward manner. Exact expressions are also derived for the higher moments of distribution. Finally, it is shown that the treatment given here is quite general and is capable of ready extension to the case of a polymer system in which the member chains possess more than t types of link.

539.19

768. STATISTICS OF COPOLYMER MOLECULAR SIZE ISTRIBUTION. L.Gold.

. chem. Phys., Vol. 30, No. 5, 1360-1 (May, 1959).

The problem of copolymerization in systems such as epoxy olymers is considered. At least four rate constants, k_{ia}, k_{ib}, pa, k_{pb} of initiation and propagation for species A and B are equired. The special case where $k_{ia} k_{pb} = k_{ib} k_{pa}$ leads to the oisson distribution, but it is doubtful if a general solution can e obtained. R.F.Barrow

539.19 : 532.77

769. ON SOME TRANSITION PHENOMENA IN AQUEOUS OLUTION OF POLYVINYLALCOHOL. T.Soeya and R.Kono.

. Phys. Soc. Japan, Vol. 12, No. 8, 950-4 (Aug., 1957).

In order to obtain information about the configurational tate of the molecule in an aqueous solution of p.v.a., the measurements of the specific volume, ultrasonic velocity and dielectric constant were carried out over a range of concentration and temperature, and the experimental result is discussed from a view point of ransition phenomena. The result seems to show that in a region of oncentration higher than a certain critical value (C_m) the configurational state of the molecule in the solution is similar to that in solid .v.a. plasticized by a solvent type plasticizer possessing no transition point, while in the region of concentration lower than C_m, only bove a certain critical temperature T_β, is a model of a spherical oiled molecule applicable. The heat of cross-linking estimated xperimentally by making use of Eldridge and Ferry's formula with espect to an apparent melting temperature of gel is about 2 kcal/mol.

539.19 : 547.96

770. MOLECULAR CONFIGURATION OF SYNTHETIC AND BIOLOGICAL POLYMERS. A.Rich.

Rev. mod. Phys., Vol. 31, No. 1, 50-60 (Jan., 1959).

A discussion of the structure of proteins and synthetic polymers. The common structural features are pointed out and the importance of the α-helix is stressed. J.Iball

539.19 : 532.77

THEORY OF DILUTE POLYMER SOLUTIONS. I. CHAIN CONFIGURATION AND LIGHT SCATTERING. See Abstr. 7843

539.19

771. NEIGHBOR INTERACTIONS AND INTERNAL ROTATIONS N POLYMER MOLECULES. III. STATISTICS OF INTERDEPENDENT ROTATIONS AND THEIR APPLICATION TO THE POLYEHTYLENE MOLECULE. S.Lifson.

. chem. Phys., Vol. 30, No. 4, 964-7 (April, 1959).

For Pt II, see Abstr. 757 (1959). The internal rotations around he skeletal bonds of polyethylene are hindered due to interaction between the neighbouring hydrogens. Since second and higher orders of neighbourhood are not negligible, the internal rotations are interdependent. The statistics of such interdependent rotations is developed and applied to obtain the configurational partition function and he mean-square end-to-end distance of the macromolecule.

539.19

772. FORCES BETWEEN MACROMOLECULES. W.H.Stockmayer.

Rev. mod. Phys., Vol. 31, No. 1, 103-6 (Jan., 1959).

A brief statement of the theory of intermolecular forces other han electrostatic or hydrogen bond forces. Beginning with small and chemically inert molecules the discussion is extended to large macromolecules and micelles such as are found in aqueous biological liquids. Application of the theory to specific systems are indicated. J.Iball

539.19

773. A METHOD FOR CALCULATING THE VIBRATIONS OF A PERTURBED ATOMIC CHAIN. O.Litzman.

Czech. J. Phys., Vol. 7, No. 4, 410-16 (1957). In Russian.

A linear atomic chain is perturbed at the points r + 1, r + 2, ..., r + s − 1. The frequencies of vibrations ω_1, ω_2 ... of this perturbed chain are studied which lie outside the interval of the continuous spectrum. A calculation is also performed for the case in which one atom only in the chain is replaced by a foreign atom. The resulting relations give the isolated frequencies sought and only have meaning as long as they give real values lying outside the interval of the continuous spectrum. The results obtained for this simple case are in agreement with the relations of Montroll and Potts (Abstr. 792 of 1956).

539.19

8774. STABILITY OF THE EQUILIBRIUM OF A CHAIN OF ATOMS. A.N.Orlov, Yu.M.Plishkin and I.M.Shepeleva.

Fiz. Metallov i Metallovedenie, Vol. 4, No. 3, 540-2 (1957). In Russian.

539.19

8775. PHYSICOCHEMICAL CHARACTERIZATION OF MACROMOLECULES. P.Doty.

Rev. mod. Phys., Vol. 31, No. 1, 61-8 (Jan., 1959).

A discussion of the application of physical chemical methods to the study of macromolecules in solution. The following techniques are described very briefly: osmotic pressure, light scattering, sedimentation, hydrodynamic methods. The features which characterize the three basic polymeric chains, polysaccharides, polypeptides and nucleic acids are indicated with examples. J.Iball

539.19 : 547.96

8776. PROTEINS AND THEIR INTERACTIONS. D.F.Waugh.

Rev. mod. Phys., Vol. 31, No. 1, 84-93 (Jan., 1959).

A discussion of the way in which several helical polypeptide chains can pack together to form large protein molecules and of the reactions which can, and which cannot, take place between molecules as a result of the packing. The way in which the chains are coiled up determines which side-chains are available for interactions; some of the changes which must occur in order to expose the hidden groups are considered and it is pointed out that some of the physical properties of proteins are a consequence of reactions between exposed side chains. J.Iball

539.19 : 548.737

8777. THREE DIMENSIONAL STRUCTURE OF GLOBULAR PROTEINS. J.C.Kendrew.

Rev. mod. Phys., Vol. 31, No. 1, 94-9 (Jan., 1959).

A description of the application of the heavy atom isomorphous replacement technique in X-ray single crystal analysis. A brief account is given of the results achieved with this method in the determination of the structure of myoglobin. J.Iball

539.19

8778. APPROACHES TO THE BIOSYNTHESIS OF PROTEINS. A.Meister.

Rev. mod. Phys., Vol. 31, No. 1, 210-20 (Jan., 1959).

A review of some of the approaches which have been made to obtain an understanding of how the wide variety of proteins known to exist can be formed from a relatively few amino acids. Experiments involving intact cells as well as those in cell-free systems are described and the results are summarized. One hundred and nineteen references. J.Iball

539.19

8779. CODING ASPECTS OF PROTEIN SYNTHESIS. C.Levinthal.

Rev. mod. Phys., Vol. 31, No. 1, 249-55 (Jan., 1959).

A survey of some of the suggestions which have been put forward to explain how the genetic information which is supposed to reside in nucleic acids can govern the synthesis of proteins. There is some evidence that a code exists which translates genetic information into amino-acid sequence in proteins but there is no evidence about the nature of the code. Experiments which might give data relating to this latter problem are discussed. J.Iball

539.19 : 577.15

8780. PROTEIN STRUCTURE AND ENZYME ACTION. H. Neurath.

Rev. mod. Phys., Vol. 31, No. 1, 185-90 (Jan., 1959).

A survey of current ideas on the relation of protein structure to enzymatic function. The following particular points are discussed: the chemical configuration of active sites; the relation of chemical configuration to specificity; the number of active sites in an enzyme; the function of the "non-active" part of the enzyme molecule. J.Iball

539.19

8781. CONFIGURATIONS OF BIOLOGICALLY IMPORTANT MACROMOLECULES IN SOLUTION. P.Doty.

Rev. mod. Phys., Vol. 31, No. 1, 107-17 (Jan., 1959).

A study of the information which has been obtained about the structure of biological polymers by the application of the methods of optical-rotatory dispersion to supplement X-ray crystal analysis and other physical techniques. Particular attention is paid to the transition from semi-rigid helix configuration to the coiled chain form in polypeptides, proteins, polynucleotides and nucleic acids.

J.Iball

539.19

8782. MOLECULAR STRUCTURE OF THE NUCLEIC ACIDS. A.Rich.
Rev. mod. Phys., Vol. 31, No. 1, 191-9 (Jan., 1959).

A summary of present knowledge of the composition and geometrical configuration of nucleic acids. Experimental data obtained from chemical experiments and from X-ray diffraction patterns are discussed. It is stressed that the study of synthetic polynucleotides has contributed to the recent advance in this field.

J.Iball

539.19

8783. BIOSYNTHESIS OF NUCLEIC ACIDS. A.Kornberg.
Rev. mod. Phys., Vol. 31, No. 1, 200-9 (Jan., 1959).

The biochemical aspects of the synthesis of ribosenucleic acid and of deoxyribosenucleic acid are outlined and some of the implications in the general field of biology are discussed. Some of the methods used in the study of biosynthesis of DNA and RNA are described and it is pointed out that new methods of separating and characterizing these macromolecules are urgently required.

J.Iball

539.19

8784. CHARGE PERMUTATION AND DISSOCIATION OF MOLECULAR IONS BY IMPACT WITH NEUTRAL MOLECULES. F.M.Rourke, J.C.Sheffield, W.D.Davis and F.A.White.
J. chem. Phys., Vol. 31, No. 1, 193-9 (July, 1959).

Resolved beams of ions with energies between 10 and 150 keV were passed through thin targets and the resulting beam analysed as to momentum and energy. Equilibrium charge ratios were obtained for various ions after passing through thin films of Ni or organic polymer. Cross-sections for several reactions of oxygen ions with gas targets were also obtained. For gaseous targets, some of the products of dissociative reactions exhibited two side peaks differing in energy from the normal peak. By relating this displacement to a velocity change produced by dissociation alone, the kinetic energy change involved in the dissociation of the ion can be calculated. Values for a number of cases are tabulated.

SOLID-STATE PHYSICS

539.2

8785. CALORIMETRIC MEASUREMENTS ON THE STRUCTURAL ENERGY OF AN ANNEALED METAL OF HIGH PURITY. H.U.Åström.
Ark. Fys., Vol. 14, Paper 17, 263-75 (1958).

See Abstr. 6498 (1958). A series of measurements in the range 100-400°C is described on 99.9% and 99.999% pure silver in argon-filled Pyrex containers. An isothermal microcalorimetric method was used. Increasing temperature leads to an isothermal absorption of energy, which becomes larger with increasing grain size and purity of the metal. The average energy of formation was 0.2 eV. Possible mechanisms for the observed phenomena are discussed.

S.Weintroub

539.2

8786. ELECTRON CLOUD OUTSIDE A METAL SURFACE. R.Holm.
J. appl. Phys., Vol. 30, No. 5, 792-3 (May, 1959).

It is shown that the attraction between parallel metal surfaces more than 10 A apart due to the electron cloud between them is negligible compared with the pressure in a metallic contact.

D.M.Edwards

539.2

8787. THE DEFORMATION POTENTIAL OF POTASSIUM CHLORIDE. H.Kawamura.
J. Phys. Chem. Solids, Vol. 5, No. 4, 256-63 (1958).

The calculation of the energy of the lowest state of a conduction electron in potassium chloride is made by means of the cellular method for various lattice parameters. The energy is as high as 8.81 eV for the normal lattice parameter, and is reduced to −3.63 eV by taking into account the exchange and overlap corrections. The deformation potential obtained directly from these values is 5.4 eV per unit dilation. The trapping state around a dislocation line and the scattering of electrons by acoustical phonons are discussed, making use of this value.

539.2

8788. DETERMINATION OF THE FORCE LAWS IN DIAMOND-TYPE CRYSTALS. D.Saint-James.
J. Phys. Chem. Solids, Vol. 5, No. 4, 337-55 (1958). In French.

Laval's theory makes a distinction between dynamic and static elasticity. It introduces, instead of the 21 coefficients of Voigt, 45 for the description of the solid behaviour. Particularly, in holoedric cubic systems when each atom is not a symmetry centre, four different coefficients are necessary. It follows that compressibility cannot be expressed with the dynamic elastic coefficients as measured by sound velocity. In fact a new relation is available which, in the case of diamond structure, allows the calculation of five force constants between the two nearest neighbours, with the help of the Raman frequency and the dynamic elastic constants. These force constants are general; no assumption is made concerning their form (e.g. central forces). More general forces than two-body forces are involved in the values obtained. The results are very different from those of Smith. The results of the experimental measurements for diamond are compared, and an attempt is made to apply the same calculation to silicon and germanium where the Raman frequency is unknown, and to discuss the infrared absorption spectra of these elements.

539.2

8789. CALCULATION OF COULOMB CRYSTAL POTENTIALS. J.L.Birman.
J. Phys. Chem. Solids, Vol. 6, No. 1, 65-8 (July, 1958).

The calculation of the lattice sums of Coulomb crystal potential is discussed. It is assumed that the electron density is spherically symmetric about each site and given in analytic form. It is shown that the total charge density at each site must be split into two parts in order to make the calculation. One part gives rise to an infinite average value of crystal potential and must be compensated. The other gives rise to a finite average potential and may (Ewald convention) or may not (Frenkel–Bethe convention) be compensated; a choice cannot at present be made between the two alternatives. It is shown that an identity exists which relates the lattice sums of potential for general densities to the Ewald sums, and hence permits simplification of the numerical calculations. The generalization to more complex densities is indicated.

539.2

8790. EFFECT OF THE LATTICE POTENTIAL ON, AND THE CONTRIBUTION OF THE SHELLS TO, POSITRON ANNIHILATION IN COPPER. E.Daniel.
J. Phys. Chem. Solids, Vol. 6, No. 2-3, 205-12 (Aug., 1958). In French.

The annihilation is investigated, taking into account the periodic potential of the lattice. It is found that annihilation with the conduction electrons takes place practically as if the positron were free with its ordinary mass. The contribution to annihilation due to d-electrons in copper is also evaluated; this term is relatively small, but the only one able to explain the "tails" with large momenta of the experimental curves deduced from γ-ray angular correlations. Collisions between electrons and the thermalized positron do not broaden the energy levels much. All these results justify the approximations made previously (Abstr. 6130 of 1958).

539.2 : 534.222.2

8791. DEDUCTION OF THE VOLUME DEPENDENCE OF THE COHESIVE ENERGY OF SOLIDS FROM SHOCK-WAVE COMPRESSION MEASUREMENTS. G.B.Benedek.
Phys. Rev., Vol. 114, No. 2, 467-75 (April 15, 1959).

By applying the Mie–Grüneisen equation of state to measurements of the compression of solids by strong shock waves, it is possible to determine the volume dependence of the cohesive energy. The method for carrying out this deduction is presented along with a detailed exposition of the underlying assumptions. The method is applied to six metals Be, Al, Co, Ni, Cu, and Ag for which the experimental data are most extensive. The volume dependence of the cohesive energy for these six metals is presented in both analytical and graphical form.

539.2

8792. APPLICATION OF THE MORSE POTENTIAL FUNCTION TO CUBIC METALS. L.A.Girifalco and V.G.Weizer.
Phys. Rev., Vol. 114, No. 3, 687-90 (May 1, 1959).

The Morse parameters were calculated using experimental values for the energy of vaporization, the lattice constant, and the compressibility. The equation of state and the elastic constants which were computed using the Morse parameters, agreed with experiment for both face-centred and body-centred cubic metals.

All stability conditions were also satisfied for both the face-centred and the body-centred metals. This shows that the Morse function can be applied validly to problems involving any type of deformation of the cubic metals.

539.2 : 548.735

8793. SOLID HARMONICS AS BASIS FUNCTIONS FOR CUBIC CRYSTALS. D.D.Betts.
Canad. J. Phys., Vol. 37, No. 3, 350-61 (March, 1959).

The various sets of basis functions useful in discussing cubic crystals must include sets of symmetrized combinations of powers of the co-ordinates orthogonalized over the cellular polyhedron. Such polynomials are here called solid harmonics. A study of the actual solid harmonics reveals the limitations of the spherical cell approximation. The solid harmonics can be used to develop a new method over the cellular polyhedron of the body-centred cubic lattice or of the face-centred cubic lattice.

539.2 : 536.631

8794. EFFECT OF THE TEMPERATURE VARIATION OF THE EQUILIBRIUM VALUE OF THE DEGREE OF [THE LATTICE] RECIPROCITY ON HEAD CAPACITY OF SPINELS. A.N.Men'.
Fiz. Metallov i Metallovedenie, Vol. 4, No. 3, 544-5 (1957).
In Russian.

539.2

8795. THE EFFECT OF THE ANHARMONICITY ON THE PROPERTIES OF CRYSTALS. W.Ludwig.
J. Phys. Chem. Solids, Vol. 4, No. 4, 283-305 (1958). In German.

In the lattice theory of crystals, one generally assumes the validity of the harmonic approximation, in which only quadratic terms are taken into account in the expansion of the potential energy in the displacements. In the present paper the influence of higher terms (anharmonicity) is investigated, and a particular example (face-centred cubic lattice with central forces between nearest neighbours only) is discussed. The free energy, from which all the thermodynamic properties of a crystal may be evaluated, is computed with the aid of a method analogous to Dirac perturbation theory. It is possible to deduce general theorems for the temperature dependence of the isothermal and adiabatic elastic constants. In no case are the Cauchy relations satisfied. It is also possible to derive relatively simple expressions for the contributions to the specific heat arising from anharmonicity. It is shown in particular, that the relation between elastic data and Debye temperature derived in the harmonic approximation is not valid even at absolute zero. An expression is also derived for the velocity of elastic waves taking into account anharmonicity. The relation between the wave velocity and the elastic constants is discussed. It appears from this that the relations deduced for cubic crystals are valid only for transverse waves. The simple example discussed would be valid for rare gases in the solid state, for which, however, only very scanty experimental data exist.

539.2 : 538.2

8796. TYPES OF MAGNETICALLY ORDERED CONFIGURATIONS ON SIMPLE LATTICES. H.A.Gersch and W.C.Koehler.
J. Phys. Chem. Solids, Vol. 5, No. 3, 180-201 (May, 1958).

A scheme for enumerating possible magnetically ordered configurations on simple lattices is described, and a system of nomenclature descriptive of the arrangement is proposed. Examples of the method as applied to simple cubic, face-centred cubic, body-centred cubic, and hexagonal layer lattices are given. Magnetic structure amplitudes for configurations based on the above lattices are tabulated.

539.2 : 536.66

8797. THE LATTICE ENERGY AND HEAT OF FORMATION OF LITHIUM MONOSULPHIDE. D.F.C.Morris.
J. Phys. Chem. Solids, Vol. 5, No. 4, 264-7 (1958).

A term-by-term theoretical calculation of the lattice energy is reported. It is computed to be $U_0 = 588.7$ kcal/mole (0°K). This value, in conjunction with known thermodynamic data, has been used to estimate the heat of formation of the compound, $\Delta Hf =$ $= 117.7$ kcal/mole (298°K).

539.2

8798. THERMODYNAMIC PROPERTIES OF A DISORDERED LATTICE. G.Weiss and A.Maradudin.
J. Phys. Chem. Solids, Vol. 7, No. 4, 327-44 (Dec., 1958).

A new method is presented for evaluating additive functions of the normal mode frequencies of disordered isotopic lattices as a perturbation-type expansion. The method is constructive; a recipe is given for writing down the general term of the expansion. The expression for the general term depends only on the evaluation of certain sums and integrals. A further advantage of the present method is that one is able to discuss the convergence of the resulting series solution. This is generally difficult, if not impossible, to do for the usual perturbation expansions. Several simple examples have been considered to illustrate the method. The generalized result of Prigogine et al. (Abstr. 9215, 11019 of 1954) is rederived for the zero-point of a one-dimensional lattice and higher-order terms in the expansion are obtained. In two dimensions the agreement between this more accurate calculation and that of Prigogine et al., indicates that their use of the Debye frequency spectrum as a zeroth approximation does not lead to appreciable error. In addition, to the present calculation of additive functions of the normal mode frequencies, one is able to discuss the low-frequency end of the frequency-distribution function.

539.2

8799. STUDIES ON THE LOWER OXIDES OF TITANIUM. A.D.Pearson.
J. Phys. Chem. Solids, Vol. 5, No. 4, 316-27 (1958).

Pure TiO is face-centered cubic above ~ 950°C. The structure of samples annealed below this temperature is complex, consisting of two or possibly three phases not in equilibrium. Impurities and excess of oxygen stabilize the face-centered cubic form at room temperature. The electrical resistivity of TiO (prepared by melting) is 2.81×10^{-4} ohm cm at room temperature, and increases with temperature between −162 and +362°C. The thermoelectric e.m.f. of TiO is of the same order of magnitude as that of metals. The measured density is less than the X-ray density, indicating that 14.6% of the lattice positions are unoccupied. The properties of the present products suggest that the TiO-phase oxides may be considered solid solutions of oxygen in titanium. X-ray investigations indicate that Ti_3O_4 probably does not exist. The trigonal unit cell of Ti_2O_3 between room temperature and 350°C is confirmed. The lattice parameters change rapidly between 160 and 200°C, corresponding to the rapid increase in magnetic susceptibility. Ti_2O_3 is antiferromagnetic; $\chi = 1.09 \times 10^{-6}$ c.g.s. units at 20°C. The thermal activation energy of electrical conduction of Ti_2O_3 in the room-temperature region is about half of the observed optical activation energy. The material is a p-type semiconductor at room temperature.

539.2

8800. THOMAS—FERMI FUNCTION FOR IMPURITY ATOM DISSOLVED IN A MATRIX METAL. K.Umeda and S.Kobayashi.
J. Phys. Soc. Japan, Vol. 13, No. 2, 148-52 (Feb., 1958).

The scale transformation was established keeping invariant the TF equation of an impurity atom dissolved with infinite dilution in a matrix metal of very large size. It enabled the double sequence of solutions of the TF equation specified by two parameters to be reduced to a single sequence of master solutions specified by one parameter only. Starting from the asymptotic expansion of solution derived here anew the inward numerical integration of the TF equation was carried out. The screened Coulomb potential was compared with numerical solutions to measure its degree of approximation.

539.2

8801. OXYGEN IMPURITY IN SILICON SINGLE CRYSTALS. A.Smakula and J.Kalnajs.
J. Phys. Chem. Solids, Vol. 6, No. 1, 46-50 (July, 1958).

Comparison of the lattice constant and density of "pure" silicon crystals and of oxygen-contaminated crystals favours the substitutional position of oxygen in the silicon lattice rather than the interstitial. The spectral position and intensities of 15 infrared absorption bands for pure silicon crystals are given. The bands shift slightly toward higher frequency at ~ −130°C, but no narrowing was detected. At −130°C the half-width of the 1106 cm^{-1} band decreases from 32 to 18 cm^{-1}, the height increases by one-third, and the maximum shifts to 1120 cm^{-1}. After heat-treatment at 1000°C for 48 hr, the intensity of the 1106 cm^{-1} band decreases strongly, and three new weak maxima appear at 1065, 1160, and 1230 cm^{-1}. The integrated intensity is lower by only 15%. The above bands coincide with the absorption bands of quartz. This indicates a segregation of SiO and the formation of SiO_2 units. Pure silicon crystals show a higher absorption tail above 1.2 μ, indicating strong strains.

539.2

8802. RELATIONS BETWEEN THE CONCENTRATIONS OF IMPERFECTIONS IN SOLIDS. F.A.Kröger and H.J.Vink.
J. Phys. Chem. Solids, Vol. 5, No. 3, 208-23 (May, 1958).

Imperfect crystals behave statistically like liquid solutions, the crystal being the solvent and the imperfections the solutes. Application of the law of mass action to atomic and electronic reactions taking place in the crystal and between the crystal and the other phases leads to the notion that the concentrations of the various imperfections are interdependent as a result of reactions having partners in common. The consequences of this interdependence are demonstrated by means of a graphical method. Imperfections having opposite effective charges tend to increase each other's concentrations. Foreign atoms are incorporated in a manner dependent both on the energy levels caused by them and on the type of imperfection prevailing in the crystal in the absence of these foreign atoms. In monatomic solids the mechanism of incorporation can be influenced only through the temperature; in compounds it can also be influenced through the partial pressures of the components of the basis crystal. It is shown that these arguments given are valid irrespective of the type of bonding.

539.2

8803. LATTICE IMPERFECTIONS IN CRYSTALS, STUDIED ON ALKALI HALIDES. Y.Haven.
Philips tech. Rev., Vol. 20, No. 2-3, 69-79 (1958-59).

Many properties of solids, including such technically important ones as electrical conductivity and dielectric losses, cannot be explained on the basis of a purely periodic structure of the crystal lattice. The observed phenomena have therefore come to be attributed to certain deviations from exact periodicity — that is to say, to lattice imperfections. The effects of lattice imperfections on the behaviour of solids can very conveniently be studied on crystals of the alkali halides, since these substances can easily be obtained in a pure state and since in their case the phenomena are often less complicated than in other cases. In this article some results of investigations on these crystals are given, with particular reference to the dielectric properties of an alkali halide (NaCl) in which certain lattice imperfections can be produced by introducing an alkaline-earth halide ($CaCl_2$).

539.2

8804. DEFECTS IN IONIC CRYSTALS. I. IMPROVEMENT OF THE METHOD OF MOTT AND LITTLETON AND ITS APPLICATIONS TO SIMPLE DEFECTS. T.Kurosawa.
J. Phys. Soc. Japan, Vol. 13, No. 2, 153-60 (Feb., 1958).

The improvement and applications are treated. The formation energies of Schottky defects in LiF, NaCl, NaBr, KCl, KBr, RbBr and AgCl crystals, and that of a Frenkel defect in AgCl crystal are calculated. More complicated defects will be treated in forthcoming papers.

539.2

8805. SELF-DIFFUSION OF BROMINE IN SILVER BROMIDE. D.S.Tannhauser.
J. Phys. Chem. Solids, Vol. 5, No. 3, 224-35 (May, 1958).

The self-diffusion constant of bromine in AgBr has been measured in the temperature range 332-415°C, where D_{Br} varies from 2.6×10^{-12} to 4.5×10^{-10} cm^2/sec. A plot of D_{Br} versus 1/T shows a definite curvature; $-R d \ln D/d(1/T)$ increases from 45 000 cal/mole at the lower end to 60000 cal/mole at the upper end of this range. D_{Br} has also been measured in 1.27% cadmium-doped AgBr and found to be smaller by 15-30%, the effect of cadmium being smaller at the lower temperature. These results do not fit into a simple theory of chemical equilibrium, and two alternative mechanisms of association between defects are invoked for an explanation. A number of experiments carried out under hydrostatic pressure give an activation volume for diffusion of ~ 44 cm^3/mole, which supports the assumption that bromine diffuses by a vacancy mechanism.

539.2 : 537.311.31

8806. ELECTRON THEORETICAL INVESTIGATIONS OF DEFECTS IN METALS. VI. THE ELECTRICAL RESISTANCE OF VACANCY PAIRS (DIVACANCIES) IN MONOVALENT METALS. H.Bross and A.Seeger.
J. Phys. Chem. Solids, Vol. 6, No. 4, 324-34 (Sept., 1958). In German.

For Pt V, see Abstr. 2912 (1959). The electrical resistivity of pairs of vacant lattice sites (divacancies) is calculated on the basis of a model which was used for the calculation of the binding energy of divacancies in an earlier paper. Provided there is no preferred orientation of the divacancies, the residual resistivity decreases by about 10% upon the association of single vacancies to divacancies. The anisotropy of the electrical resistivity of aligned divacancies has been calculated. It is shown that the deviations from Matthiessen's rule and presumably also the magneto-resistivity due to divacancies are negligible. In order to find the low temperature resistivity of divacancies it was necessary to employ the variational principle. The convergence of the variational method is investigated in the appendix. As a test problem with known solution the electrical resistivity of a screw dislocation has been treated. The convergence was found to be quite good.

539.2 : 534.23

8807. ULTRASONIC ATTENUATION BY ELECTRONS IN METALS. E.I.Blount.
Phys. Rev., Vol. 114, No. 2, 418-36 (April 15, 1959).

The calculation of ultrasonic attenuation is discussed for arbitrary frequency and band structure. The results are applied to the cases of a metal with a spherical energy surface and a semimetal with electrons in two "valleys". Possible experimental uses are pointed out. The occurrence of saturation is discussed. The acoustoelectric effect is also treated by similar methods and is seen to be closely related to the attenuation.

539.2 : 548.574

ETCH PATTERNS IN ZINC. See Abstr. 7602

539.2 : 537.311.32

TRANSIENT ELECTRICAL EFFECTS OF PLASTIC DEFORMATION IN NaCl CRYSTALS. See Abstr. 8094

539.2

8808. OBSERVATION OF SEVERAL ASPECTS OF THE CRYSTALLINE LATTICE OF COPPER PHTHALOCYANIN. H.Espagne.
C.R. Acad. Sci. (Paris), Vol. 247, No. 25, 2318-21 (Dec. 22, 1958). In French.

The author has studied dislocations in the $20\bar{1}$ planes of copper phthalocyanin crystals by direct observation in the electron microscope. By superimposing two crystals oriented at different angles moiré patterns are readily observed which confirm the existence of such dislocations. A.E.I. Research Laboratory

539.2

8809. DECORATION OF DISLOCATIONS IN ALKALI HALIDE WHISKERS. S.Amelinckx.
J. appl. Phys., Vol. 29, No. 11, 1610-11 (Nov., 1958).

Diffusion of Au into NaCl whiskers revealed a variety of dislocation configurations. R.F.Peart

539.2

8810. RELATION BETWEEN GENERATION AND MOTION STRESS OF DISLOCATIONS IN InSb. J.D.Venables and R.M.Broudy.
J. appl. Phys., Vol. 30, No. 1, 122 (Jan., 1959).

By careful interpretation of figure 7 in a previous paper (Abstr. 805 of 1959), the authors purport to show that in InSb the stress required to generate dislocations in a dislocation source is greater than the stress required to move them in the slip-plane. This interpretation is only possible because of the unique action of the etch on single crystals of InSb, which allows one to distinguish between positive and negative dislocations. R.Bullough

539.2

8811. STRESS-ASSISTED PRECIPITATION ON DISLOCATIONS. F.S.Ham.
J. appl. Phys., Vol. 30, No. 6, 915-26 (June, 1959).

The kinetic theory for the rate of stress-assisted precipitation on dislocations is re-examined in order to extend the work of Cottrell and Bilby (Abstr. 1204 of 1949). Two approximate expressions are used for the elastic interaction between a solute atom and edge and screw dislocations: $V = -A \sin\theta/r$ and $V = -B/r$, respectively. The resulting partial differential diffusion equations are integrated numerically to get the time-dependent rate of precipitation on an isolated dislocation. These results are used to calculate the short-time part of the precipitation curve for an array of dislocations. Exact steady-state solutions to the diffusion equations are derived for both interactions and are used with a variational procedure to establish the long-time part of the curve for a regular array. For very short times the precipitated fraction W is proportional to $t^{2/3}$ as derived by Cottrell and Bilby, but this result is not accurate over the range of t during which most of the precipitation occurs. The ong-time part of the curve is given accurately by $W = 1 - \exp(-t/\tau)$, where τ can be calculated by replacing each dislocation and its stress field by a cylinder with an "effective capture radius", the value of which is calculated for each form of interaction. Complete precipitation curves are obtained for a regular array by combining the short- and long-time results, and it is shown that these are changed but slightly if the array is random. These results differ significantly from a formula suggested by Harper (Abstr. 8246 of 1951) to extend Cottrell and Bilby's work, and they thereby indicate that the interpretation of the precipitation process for carbon in lpha-iron is not yet entirely established.

539.2

8812. DETERMINATION OF DISLOCATION DENSITIES THROUGH NUCLEAR RESONANCE STUDIES.

E.Otsuka and H.Kawamura.
J. Phys. Soc. Japan, Vol. 12, No. 10, 1071-82 (Oct., 1957).

Studies of quadrupolar effects of mixed alkali halides on nuclear resonance previously reported for Na in NaCl—NaBr have been extended to Br in KBr—NaBr. The amplification factor for eQq is thus derived, and making use of this factor densities of dislocation are determined for a series of plastically deformed crystals of KBr. Although the effects of the screw and edge dislocations are additive for the broadening of the spectral line, their contributions to the net shift of the centre of gravity of the line are in the opposite directions for $H_0//[100]$. Hence the two kinds of dislocation are separable in density through the measurement of the breadth and asymmetry of the spectral line. Extrapolation to zero strain shows that for an undeformed crystal screw and edge dislocations are nearly balanced in number and their total density lies around 4×10^3 cm^{-2}. Linear compression favours the production of screw dislocations more than that of edge dislocations, and the density of each type dislocation increases quite linearly with strain up to 40% deformation. For the heaviest deformed sample the total dislocation density achieved was about 3×10^9 cm^{-2}.

539.2

8813. LATTICE THEORY OF SCREW DISLOCATION IN ALKALI METALS.

C.Lehmann and G.Leibfried.
J. Phys. Chem. Solids, Vol. 6, No. 2-3, 195-204 (Aug., 1958).
In German.

A screw dislocation in the direction of the edge of a cube is treated. The dislocation width is determined by a variational principle for the energy, and is compared with the Peierls model. The dislocation width σ, unlike the Peierls model ($\sigma = a/4$) varies considerably with position: a/5 in the stable, a/9 in the unstable position (a is the cubic lattice constant). The resulting value of the Peierls force τ_p is modified considerably by the strong position-dependence of the dislocation width: $\tau_p = 9 \times 10^{-2} c_{44}$ in the Peierls model, $4 \times 10^{-3} c_{44}$ by the corresponding calculation using lattice theory (c_{44} modulus of rigidity).

539.2

8814. SCREW DISLOCATIONS AND DISCRETE ELASTIC THEORY.

A.A.Maradudin.
J. Phys. Chem. Solids, Vol. 9, No. 1, 1-20 (Jan., 1959).

A simple model of a screw dislocation in a crystal lattice in which each atom interacts with its neighbours through Hooke's law forces is presented, and expressions for the displacement component and strain energy are obtained. Applications of the model to screw dislocations in alkali-halide crystals are discussed.

539.2

8815. THE THEORY OF SMALL ANGLE SCATTERING OF X-RAYS AND NEUTRONS FROM EXTENDED DISLOCATIONS IN SOLIDS.

A.Seeger and E.Kröner.
Z. Naturforsch., Vol. 14a, No. 1, 74-80 (Jan., 1959). In German.

Hitherto all treatments of small angle scattering from lattice imperfections expressed the scattered intensity as an integral over the extended region of the dislocation. It is now proposed to describe the process in terms of an integral over the dislocation density, within the domain of first-order elasticity theory. In case of dislocation lines (singular dislocations) this integral reduces to the line integral along the fault and a considerable simplification in the calculation of the scattering amplitude is achieved. As an example, small angle scattering by circular dislocation loops is presented. The behaviour of such loops which may occur by condensation of vacancies in crystals has received considerable attention recently and application to processes in quenched metals is discussed.

S.J.St-Lorant

539.2 : 537.311.33

DISLOCATION PLANES IN SEMICONDUCTORS.

See Abstr. 8140

539.2

8816. EXPERIMENTAL DETERMINATION OF STACKING-FAULT ENERGIES IN FACE-CENTRED CUBIC METALS.

A.Seeger, R.Berner and H.Wolf.
Z. Phys., Vol. 155, No. 2, 247-62 (1959). In German.

Experimental and theoretical results are given which enable one to determine the absolute values of stacking-fault energies from the stress—strain curves of single crystals. The activation energy for the cross-slip of screw-dislocations is calculated as a function of the stacking-fault energy γ, the applied shear stress τ, and the size of the piled-up dislocation groups. An experimental value for the activation energy for cross-slip in copper is deduced from the strain-rate dependence of the shear stress τ_{III} at the beginning of stage III of the stress—strain curve. Comparison between experiment and theory gives $\gamma_{Cu} = 170$ ergs/cm^2. The determination of the stacking-fault energy of other f.c.c. metals is possible by comparing the temperature dependence of τ_{III}. Experimental results are given for Au and Cu. Data from the literature are used for Ag, Ni, and Al. It was found that $\gamma_{Au} = 30$ ergs/cm^2. The difference in stacking-fault energy of Cu and Au is much larger than was anticipated. It is substantiated, however by a number of observations discussed in the paper. Constriction energies calculated on the basis of the newly determined stacking-fault energies are given.

539.2 : 539.27 : 538.2

ELECTRON MIRROR MICROSCOPY OF MAGNETIC STRAY FIELDS ON GRAIN BOUNDARIES.

See Abstr. 8301

539.2

8817. EXTREME FREQUENCIES OF LATTICE VIBRATIONS FOR DISORDERED BINARY ALLOYS.

G.F.Newell.
J. Phys. Chem. Solids, Vol. 6, No. 2-3, 190-4 (Aug., 1958).

The extreme frequencies of various branches of the spectrum for a binary substitutional alloy can be estimated by using a variational procedure. In particular, the maximum frequency of the optical modes can be determined approximately as a function of the various force constants and the composition.

539.2 : 536.631

8818. A HEAT-CAPACITY FUNCTION WITH VELOCITY DISPERSION FOR ISOTROPIC SOLIDS.

S.W.Barber and B.Martin.
J. Phys. Chem. Solids, Vol. 9, No. 3-4, 198-213 (March, 1959).

Structural interpretation of the low-temperature heat capacities of glass has required the derivation of a new function for the lattice heat capacities of isotropic solids. The new formulation permits estimates to be made of acoustic cut-off frequencies and corresponding limiting wavelength. The latter is twice the effective mean distance between centres of primitive cells. No primitive cells are known for glasses from independent evidence. Consequently, the function is verified by comparison with the lattice heat capacities of monatomic crystals having one-atom primitive cells. Deviations from the function are expected because of the unavoidable anisotropies of the crystals, but these are surprisingly small and easily recognizable. Except for these deviations and uncertainties in experimental lattice heat capacities, the function appears to agree well with experiment at all values of C_V up to its classical limit. The function is applied to diamond, which has a two-atom primitive cell, to illustrate the manner in which wrong choices of the cell become evident. For both diamond and NaCl, it is shown that this scheme of calculation yields results in good accord with published calculations on lattice dynamics. Application of the function to glasses involves unique considerations which are not discussed here. The function can be used to make approximate calculations for moderately anisotropic crystals.

539.2

8819. LATTICE VIBRATIONS OF SEMICONDUCTORS BY NEUTRON SPECTROMETRY.

B.N.Brockhouse.
J. Phys. Chem. Solids, Vol. 8, 400-5, 421-2 (Jan., 1959).

Rochester Semiconductors Conference Paper (see Abstr. 4569/1959). By the study of the energy distribution of neutrons scattered by a single crystal it is possible to determine the frequency—wave number relation (ν (q) relation) of the normal modes of the crystal. In this paper the ideas involved are reviewed and discussed with particular application to the diamond-type lattices of silicon and germanium. The published ν (q) relation for germanium determined by Brockhouse and Iyengar, and its relation to elastic constant, specific heat, and infrared measurements in the literature, is discussed. By comparing similar measurements in the literature for silicon with those for germanium, in the light of the new knowledge of the lattice frequencies for germanium, it is concluded that the lattice frequencies for silicon are higher than those for germanium at the same position in the zone, by a roughly constant factor of 1.75. The Raman frequency for silicon is deduced to be 515 cm^{-1}.

539.2

8820. LATTICE VIBRATIONAL SPECTRUM OF GERMANIUM. F.Herman.
J. Phys. Chem. Solids, Vol. 8, 405-18, 421-2 (Jan., 1959).

Rochester Semiconductors Conference Paper (see Abstr. 4569/1959). The Born—von Karman theory of crystal dynamics is applied to the diamond structure, and the most general force system involving interactions between each atom and its first through sixth order neighbours has been derived. The macroscopic elastic constants and the frequencies of selected lattice vibrational modes have been expressed in terms of the 21 independent parameters entering into this force system. It is shown that the experimental elastic constants and lattice frequencies along the [100] and [111] axes cannot be fitted to force models based only on general 1° and 2° neighbour interactions. The addition of general 3° and 4° neighbour interactions does not improve the situation, but the further addition of 5° (and higher order) neighbour interactions does. It is possible to obtain physically plausible force models which fit all the data considered within experimental error by the use of only general 1° through 5° interactions. The nature and the limitations of the derived force models will be discussed.

539.2

8821. ON THE MOTION OF A PARTICLE COUPLED TO LATTICE VIBRATIONS. T.A.Bak, M.Goche and F.Henin.
Molecular Phys., Vol. 2, No. 2, 181-9 (April, 1959).

The approach to equilibrium of a particle interacting with the vibrations of an equilibrium lattice is studied using the methods developed by Prigogine and co-workers. For a low energy particle it is found that the approach to equilibrium is characterized by a relaxation time which is proportional to the square of the mass of the particle, and that the autocorrelation function is a simple exponential function. For a high energy particle no ordinary relaxation time exists, and the apparent relaxation time increases proportionally to the three halves power of the energy of the particle, and is inversely proportional to the square root of its mass. The fact that it depends on the energy is understood when one considers the number of phonons with frequencies high enough to make interaction possible.

539.2

8822. EXACT CALCULATION OF FRANCK—CONDON INTEGRALS. M.Wagner.
Z. Naturforsch., Vol. 14a, No. 1, 81-91 (Jan., 1959). In German.

The vibrational contribution to the Franck—Condon integrals for optical and radiationless transitions between electronic states in a crystal disturbance can be accurately calculated with the assumption that the vibration frequencies are not changed in the transition. The integrals can be represented by Laguerre polynomials. R.C.Seymour

539.2

8823. THE EFFECTIVE ELECTRON RADIUS IN CRYSTAL LATTICES. A.F.Kapustinskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 124, No. 6, 1265-6 (1959). In Russian.

It is shown that the effective electron radius calculated by three different methods from the data on the ionic and atomic radii is equal 0.78 ± 0.02 A, and that this value remains constant within 0.1-0.2 A in metals which can be regarded as systems consisting of cations of the noble gas type and electrons. M.H.Sloboda

539.2

8824. ON THE THEORY OF THE INTERNAL FIELD EMISSION. J.Kamphusmann.
Z. Naturforsch., Vol. 14a, No. 2, 165-71 (Feb., 1959). In German.

The problem of the solution of the Schrödinger equation for a periodic lattice potential when a strong applied field potential term is included is considered. An approximate solution by elimination of this non-periodic term leads to the treatment of internal field emission as a one-electron process. G.F.J.Garlick

539.2

8825. THE EFFECT OF THE MAGNETIC FIELD ON THE ELECTRON DENSITY DISTRIBUTION IN CADMIUM SULPHIDE CRYSTALS. G.G.Aĭgler.
Zh. tekh. Fiz., Vol. 28, No. 9, 1933-4 (1958). In Russian.

The variation of the electron density distribution in CdS crystals in a magnetic field varying between 2000 and 10 000 gauss was studied by the Weisenberg technique. It is postulated that the decrease of conductivity observed in the investigated specimens placed in a magnetic field was due to the destruction of the electron bridges which, according to Shuvalov (Abstr. 1738 of 1957) are formed between the neighbouring atoms of illuminated or heated crystals. M.H.Sloboda

539.2

8826. ON THE BAND STRUCTURE OF TELLURIUM. A.P.de Carvalho.
C.R. Acad. Sci. (Paris), Vol. 248, No. 6, 778-81 (Feb. 9, 1959). In French.

Calculations made using the tight-binding approximation agree well with deductions from experiment. C.A.Hogarth

539.2

8827. THE ELECTRONIC BAND STRUCTURE IN IRON—CHROME ALLOYS. N.D.Borisov, V.V.Nemoshkalenko and A.M.Fefer.
Dokl. Akad. Nauk SSSR, Vol. 121, No. 2, 264-7 (1958). In Russian.

The σ-phase and the α-σ transition were studied by measuring the change in the fine structure of X-ray spectral lines correspondin to transitions from the outer shells to the K-shell. The distribution functions of the occupied electron states in the conduction band were deduced from the shapes of the observed emission lines. The result give the temperature variation in the energies of the conduction band, the value of the Fermi energy in both α- and σ-phases, and the variation in the band structure of the alloys with concentration. M.G.Priestley

539.2

8828. AN EXPERIMENTAL DETERMINATION OF THE FERMI SURFACE IN LEAD. A.V.Gold.
Phil. Trans. A, Vol. 251, 85-112 (Nov. 6, 1958).

The oscillatory variation of magnetic moment with magnetic field (de Haas—van Alphen effect) has been studied in lead single crystals in the range 1.2 to 4.2°K and at fields up to 80 kG using an impulsive field technique. The oscillations consist of several terms with periods ranging from $0.53 \times 10^{-8}G^{-1}$ to $5.4 \times 10^{-8}G^{-1}$. Particular attention has been paid to the variation of the periods with orientation of the field relative to crystal axes and the shape of the Ferm surface has been inferred from these results. The Fermi surface is found to consist of several pieces and application of the simple free-electron model has enabled these pieces to be fitted into the Brillou zone scheme in a consistent manner. The surfaces are (i) a sphere containing holes in the second zone, (ii) a multiply connected surface containing electrons in the third zone, and (iii) six "cushion-shaped" surfaces containing electrons in the fourth zone. The volumes within the surfaces have been estimated, giving roughly 0.45 hole per atom in the second zone and 0.45 electron per atom in the third and fourth zones, and the interpretation is consistent with ascribing a total of four oscillations, "effective mass" values have been obtaine using these data and the dimensions of the various surfaces, an estimate has been made of the electronic specific heat constant γ and the probable form of the curve of density of states against energy is indicated. The proposed Fermi surface is shown to be reasonably consistent with other experimental evidence. The field and orientation dependence of the de Haas—van Alphen amplitudes are discusse and the experimental amplitudes are compared with the theoretical amplitudes given by Lifshitz and Kosevich (1955); while the amplitudes of some of the oscillations are found to be considerably greate than those given by theory, others become unobservably small over large angular ranges. The de Haas—van Alphen effect has also been studied in dilute lead—bismuth alloys but no simple interpretation has been found for the observed changes in period.

539.

8829. DEPENDENCE OF THE ZONE STRUCTURE OF AN ALLO OF THE AB$_3$ TYPE ON THE DEGREE OF ORDER. A.I.Gubanov.
Zh. tekh. Fiz., Vol. 28, No. 10, 2109-14 (1958). In Russian.

The effect of ordering on the electron conduction band of an alloy of the AB$_3$ type with a f.c.c. crystal structure is analysed by the method proposed by A.A.Smirnov (Zh. eksper. teor. Fiz., Vol. 17, 730, 1947). It is shown that the disorder—order transformation is accompanied by the change of sign of the current carriers, and that an ordered alloy of the AB$_3$ type is characterize by p-type conductivity. M.H.Slobod

539

8830. EQUIVALENT PERIODIC POTENTIALS. O.Steinmann.
Helv. phys. Acta, Vol. 30, No. 6, 515-20 (1957). In German.

Analysis of the state of motion of an electron in a one-dimenonal periodic potential field in a solid. It is shown that the po- ntial is not uniquely determined by the appropriate effective ectron mass. C.A.Hogarth

539.2

31. ON THE THEORY OF PLASMA WAVES IN A EGENERATE ELECTRON LIQUID. V.P.Silin.
. eksper. teor. Fiz., Vol. 34, No. 3, 781-2 (March, 1958). Russian. English translation in : Soviet Physics — JETP ew York), Vol. 34(7), No. 3, 538-9 (Sept., 1958).

A dispersion relation for plasma oscillations is derived from ndau's theory of a degenerate Fermi liquid (Abstr. 8604 of 1956). e numerical quantities appearing in this formula are estimated a typical metal, showing that the deviation from the corresponding rmula for a degenerate electron gas is appreciable.
O.Penrose

539.2

32. A THEORY OF NON-RADIATIVE TRANSFER OF XCITATION ENERGY IN SOLIDS. M.Trlifaj.
zech. J. Phys., Vol. 7, No. 1, 1-10 (1957).

Continuing the theory given in a previous paper (see Abstr. 65 of 1956), the non-radiative transfer theory of energy in solids given for the case when sensitizer and activator impurities teract with the vibrational states of the host lattice.
G.F.J.Garlick

539.2 : 537.311.33

33. ENERGY ABSORPTION BY CHARGE CARRIERS OF EGATIVE EFFECTIVE MASS IN CRYSTALS. C.Kittel.
roc. Nat. Acad. Sci. U.S.A., Vol. 45, No. 5, 744-7 (May, 1959).

Some consequences are examined of negative masses resulting om the effective mass approximation. It is shown that negative sistance and cyclotron resonance characterized by emission are ly possible with special non-equilibrium carrier distributions intained by auxiliary power sources. J.W.Leech

539.2

34. MODIFIED BOHM AND PINES COLLECTIVE DESCRIPTION F ELECTRON INTERACTIONS IN CRYSTALS. II. J.Śledzik.
ta phys. Polon., Vol. 18, No. 1, 57-73 (1959).

For Pt I, see Abstr.6245 (1959). The canonical transformation ich excludes from the Hamiltonian the interaction term $\hat{H}_{\text{inter}}$ is alysed. It is proved that the transformation, applied in approxi- ation of first commutators with generating function of transforma- on, leads to changed subsidiary conditions and a new Hamiltonian pressed in the Bohm–Pines representation. It is pointed out, that cause of the approximation degree used in applying the transforma- on, the set of supplementary conditions and the new Hamiltonian ust be considered as the equations which are rather postulated than rrectly derived. There are also obtained generalized dispersion lations.

539.2 : 530.145

35. ELECTRON INTERACTIONS. I. FIELD THEORY OF A EGENERATE ELECTRON GAS. D.F.DuBois.
n. Phys. (New York), Vol. 7, No. 2, 174-237 (June, 1959).

The method of Gell-Mann and Brueckner for treating electron teractions in a degenerate electron gas is generalized using the eynman–Dyson techniques of field theory. A Feynman propagator constructed for the effective interaction between electrons which kes into account the polarizability of the medium of unexcited rticles in the Fermi sea. The well-known plasmon excitation pears as a singularity in this propagator. The plasmon is seen be a correlated, resonant oscillation of the electron density field hich is damped by transferring its energy to less correlated, ultiple excitations. General expressions for the plasmon dispersion lation and for the plasmon level width are derived in terms of the larizability of the many-body medium. The self-energies of the west states of the electron gas are discussed by using the adiabatic eorem. This enables us to derive an exact expression for the ound state energy in terms of the polarizability. A formal calcu- ion of the ground state energy to third order in the inter-electron acing is carried out. Because of the degeneracy of the excited tes of the noninteracting system, the adiabatic transforms of ese states are not stationary states of the interacting system. wever, as the momenta of the excited particles approach the rmi momenta these states become asymptotically stationary. For tes with only a few excited particles present an independent rticle model is valid with the result that only the Feynman prop- ator for the physical one-particle state is needed. This propagator, which is corrected for the virtual polarization of the medium by the particle, provides all the information concerning the energies and damping of the single particle states.

539.2

8836. EXPERIMENTAL DETERMINATION OF THE MEAN FREE PATH IN COBALT. F.Savornin.
C.R. Acad. Sci. (Paris), Vol. 248, No. 17, 2458-60 (April 27, 1959). In French.

A study of the variation of resistance with thickness of thin Co films prepared and measured in vacuo leads to a value for the electronic mean free path of 100 ± 15 A. C.A.Hogarth

539.2 : 548 : 536.21

THERMAL RESISTANCE DUE TO ISOTOPES AT HIGH TEMPERATURES. See Abstr. 8024

539.2

8837. THEORY OF THE NON-RADIATIVE RECOMBINATION OF ELECTRONS AT PERTURBATION CENTRES IN POLAR CRYSTALS. M.Trlifaj.
Czech. J. Phys., Vol. 7, No. 6, 657-66 (1957).

Non-radiative recombination of electrons at a perturbation centre in a polar crystal is considered as a single phonon transition of a polaron in a non-adiabatic approximation from the continuous spectrum to the discrete excited state in a perturbation centre. The perturbation causing a transition is taken as the interaction of a polaron with a "free" phonon field leading to the production and disappearance of phonons in the neighbourhood of the perturbation centre. Calculation is carried out of the recombination coefficient and the effective cross-section for recombination as a function of the temperature for perturbation centres of the Coulomb type in crystals of ZnS.

539.2

8838. THE RELATION BETWEEN THE ELECTRON–PHONON AND ELECTRON–IMPURITY INTERACTION COEFFICIENTS IN METALS. V.L.Bonch-Bruevich.
Dokl. Akad. Nauk SSSR, Vol. 124, No. 6, 1233-5 (Feb. 21, 1959). In Russian.

First the electron–phonon interaction is considered and an expression is derived for the additional electron energy due to displacement of the metal ions by phonons. This interaction constant is then directly related to the screening radius in a static field of free electrons. The electron–impurity interaction is also expressed in terms of this radius. The validity of this relation depends on the fact that the phonon frequencies are much less than the Fermi frequency and thus the additional field due to lattice vibrations can be regarded as static in its action on the electrons.
M.G.Priestley

539.2 : 537.322

PHONON-DRAG THERMOMAGNETIC EFFECTS IN N-TYPE GERMANIUM. See Abstr. 8175

539.2

8839. ROLE OF INTERELECTRON COLLISIONS IN METALS IN THE INFRARED REGION OF THE SPECTRUM.
G.P.Motulevich and A.A.Shubin.
Zh. eksper. teor. Fiz., Vol. 34, No. 3, 757-8 (1958). In Russian. English translation in: Soviet Physics — JETP (New York), Vol. 34(7), No. 3, 520-1 (Sept., 1958).

Measurements of the optical constants of silver indicate that the contribution of interelectron collisions to the real part of the surface impedance becomes substantial in the spectral region of 1-6μ. Assuming that the Fermi surface is isotropic, the electron velocity on the Fermi surface is obtained for silver, $v = 2.4 \times 10^8$ cm sec^{-1}. Similar measurements in this region on lead and tin, lead to the same conclusions and approximate values for the microscopic parameters N and v are given. S.J.St-Lorant

539.2

8840. THE INTERACTION OF EXCITONS WITH THE OSCILLATIONS OF THE CRYSTAL LATTICE. M.Trlifaj.
Czech. J. Phys., Vol. 7, No. 4, 379-89 (1957). In Russian.

A study was made of the energy spectrum of a Frenkel type exciton which is in interaction with the oscillations of the crystal lattice for two limiting cases: for the case of weak interaction with the oscillations of the lattice, and for the case of a "localized" exciton. The problem is solved by variation calculus analogous to the method of Gurari (Abstr. 4476 of 1953) and Tyablikov (Abstr. 5776 of 1953), employed in the theory of polarons. In both cases an increase in the effective mass of the exciton and decrease in the bottom if its energy band was obtained. A criterion was found making possible the quantitative determination of the character of coupling of the exciton with the oscillations of the lattice.

539.2

8841. THE MEAN FREE PATH OF EXCITONS IN THE PRESENCE OF DISLOCATIONS. L.Hrivnák.
Czech. J. Phys., Vol. 7, No. 4, 390-6 (1957). In German.

The effect of edge dislocations on the mean free path of non-localized excitons is studied theoretically. Because of the finite lifetime of excitons, their motion is affected when the dislocation density exceeds a certain limit. At temperatures near 0°K, the effect of a high density of dislocations on the mean free path of excitons is greater than that of the thermal lattice vibrations.
J.Franks

539.2

8842. THE PROPERTIES OF EXCITONS PRODUCED DURING THE TRANSITION OF FAST CHARGED PARTICLES THROUGH A CRYSTAL. M.Trlifaj.
Czech. J. Phys., Vol. 7, No. 6, 667-73 (1957).

539.2

8843. INTERACTION OF EXCITONS WITH LATTICE VIBRATIONS. B.Goodman and O.S.Oen.
J. Phys. Chem. Solids, Vol. 8, 291-4, 302-4 (Jan., 1959).

Rochester Semiconductor Conference Paper (see Abstr. 4569/1959). Report given of a calculation of the thermal dissociation rate of excitons in polar materials based on the Huang—Rhys theory of multiphonon transitions. L.Pincherle

539.2

8844. EXCITON STATES IN RARE-GAS CRYSTALS. R.S.Knox.
J. Phys. Chem. Solids, Vol. 9, No. 3-4, 238-64 (March, 1959).

A formulation of Frenkel's theory of excitons is given in which a general method of constructing orthonormal one-electron trial exciton functions from atomic functions is outlined, and excitation energies, band structure, effective masses, and integrated absorption cross-sections are computed in an approximation which includes atomic spin—orbit interaction and overlapping of atomic wave functions through terms of the order S^2. A treatment of singlet and triplet states built from the atomic p^5s configuration in a cubic lattice is given as an example which is intended to apply to the lowest excited states of the rare gases themselves or to corresponding states of halide lattices on a simple excitation model. With the omission of momentum-dependent terms, the formalism is applicable to computations of first-order excitation energies in systems involving substitutional impurities.

539.2

8845. EXCITON STATES IN CRYSTALLINE ARGON. R.S.Knox.
J. Phys. Chem. Solids, Vol. 9, No. 3-4, 265-80 (March, 1959).

The formalism of the preceding paper is applied numerically to exciton states in crystalline argon arising from the atomic $3p^54s$ configuration. Under the assumptions that higher configurations do not perturb the energies and transition probabilities and that the Löwdin symmetrical orthogonalization process converges at terms of order S^2, the Frenkel model predicts two exciton absorption lines at 9 eV (±1 eV) separated by 0.2 eV and having a combined integrated absorption coefficient of the order of 10^6 cm^{-1} eV. The estimated computational error in excitation energy arises not from the neglect of any important interactions but from difficulties in evaluating two- and three-centre integrals and from the natural inaccuracy of the atomic Hartree—Fock functions. Exciton effective masses are relatively insensitive to the direction of exciton momentum, are of the order of +5 electron masses, and are found to depend primarily on exchange and overlap interactions rather than the Heller—Marcus long-range interaction. It is suggested that closely related overlap and exchange terms may be of considerable importance in the attractive part of crystal binding energies, particularly in the rare gases.

539.2

8846. THE EFFECT OF LATTICE VIBRATIONS ON THE ENERGY AND LIFETIME OF EXCITONS. H.Haken.
Z. Phys., Vol. 155, No. 2, 223-46 (1959). In German.

The exciton is treated as a system of two particles which interact via a Coulomb potential — $e^2/\epsilon_\infty r$ and are coupled to the quantized field of lattice vibrations. The ground state energy of the total system is calculated by means of a field theoretical variational method of Feynman. Generally, the results are better than all those hitherto published. By means of an extension of Feynman's method, which, however, invalidates in general the variation principle, energies and lifetimes of excited states at temperatures $T > 0^\circ$K are calculated.

539.2

8847. THE EFFECT OF NON-UNIFORM ELECTRIC FIELD ON DIFFUSION OF EXCITONS. É.S.Gribnikov and É.I.Rashba.
Zh. tekh. Fiz., Vol. 28, No. 9, 1948-58 (1958). In Russian.

As a result of the induced dipole moment, an exciton moving in a non-uniform electric field is drawn into the strong electric field region. If an exciton is characterized by a permanent dipole moment, it can be both drawn into and ejected from a strong electric field. The authors obtained a solution of the diffusion equation containing terms which describe the effect of a non-uniform field on an exciton in the sub-surface region characterized by deflection of the energy bands. At a given deflection of the energy bands, the effect of variation of the exciton concentration is multiplied, as the rate at which the field diminishes with the depth of the specimen, increases. As a rule, the effect of the band deflection on the effective life-time of excitons cannot be expressed in terms of variation of the surface recombination velocity, and this should result in a change of the spectral dependence of the life-time. The investigated effect is observed at low temperatures only.
M.H.Sloboda

539.2

8848. EXCITONS IN IONIC CRYSTALS WITH THE INTERMEDIATE COUPLING FORCE. I.M.Dўkman and I.G.Zaslavskaya.
Zh. tekh. Fiz., Vol. 28, No. 9, 1959-65 (1958). In Russian.

Interaction between exciton and the ionic crystal lattice was analysed by the method proposed by Buimistrov and Pekar (Abstr. 2154 of 1958). For all values of the crystal parameters the energy level of the system was lower than that of the H-like system. As a result of the interaction between exciton and the lattice, with the increasing value of the coupling force as characterised by n^2c, the exciton energy linearly decreases at a rate which may suddenly increase at a certain value of n^2c. The two types of exciton obtained by Dykman and Pekar (Trudy Instituta Fiziki Akademii Nauk USSR, No. 3, 92, 1952) appear to have a physical basis, and from the point of view of the more general method can be regarded as the limiting cases of excitons with weak and strong coupling. M.H.Sloboda

539.2

8849. THE THEORY OF POLARONS WITH ARBITRARY COUPLING FORCES BETWEEN THE ELECTRONS AND OPTICAL LATTICE VIBRATIONS. S.I.Pekar and V.M.Buimistrov.
Zh. tekh. Fiz., Vol. 27, No. 11, 2667-9 (Nov., 1957). In Russian.
English translation in : Soviet Physics — Technical Physics (New York), Vol. 2, No. 11, 2478-9 (Nov., 1957).

An analytic expression for the polaron energy (ground state and momentum dependence) is derived, which agrees with the perturbation result in the weak-coupling limit, and with the adiabatic approximation in the strong-coupling limit; some numerical results are given for the latter case. J.Hawgood

539.2 : 537.311.31

ACTIVATION ENERGIES FOR THE PRODUCTION AND MIGRATION OF VACANCIES IN PLATINUM. See Abstr. 8086

539.2

8850. CYCLOTRON RESONANCE IN METALS.
M.Ya.Azbel' and E.A.Kaner.
J. Phys. Chem. Solids, Vol. 6, No. 2-3, 113-35 (Aug., 1958).

The surface impedance of a metal in a high-frequency electromagnetic field and a constant magnetic field parallel to the surface of the metal is calculated, for arbitrary dispersion law and collision integral. The dependence of the surface impedance on magnetic field and temperature is investigated over the whole range of magnetic fields. The possibilities of establishing the form of the Fermi surface, the electron velocities at the Fermi surface, and the electron transition probabilities due to collisions are investigated. The predictions of the theory are compared with experimental results on cyclotron resonance in metals.

539.2

8851. STARK EFFECT FOR CYCLOTRON RESONANCE IN DEGENERATE BANDS. J.C.Hensel and M.Peter.
Phys. Rev., Vol. 114, No. 2, 411-17 (April 15, 1959).

A calculation of the motion is given for an electron in a simple band subjected to perpendicular magnetic and electric fields. It is shown that the cyclotron resonance frequency is unaffected by the presence of the electric field. For degenerate bands, however, there s a Stark shift of the cyclotron transitions between the low-lying 'quantum" states. Calculations using second-order perturbation heory indicate that fractional line shifts of $\Delta\nu/\nu_0 \sim 10\%$ may be obained under reasonable experimental conditions. This effect may be useful in the study of the valence bands of germanium and silicon.

539.2 : 538.27

8852. ELECTRON SPIN RESONANCE IN CRYSTALS OF THE NaCl TYPE CONTAINING AN EXCESS OF METAL ATOMS.

M.D.Glinchuk and M.F.Deĭgen.

Zh. tekh. Fiz., Vol. 28, No. 9, 1981-90 (1958). In Russian.

The hyperfine structure of the energy levels of a valence electron of an interstitial metal introduced into the NaCl type lattice s calculated. The spin Hamiltonian of the system is calculated in he two limiting cases of the radius of the electron state much greater than and much less than the lattice constant. The parameters of the absorption bands in the paramagnetic resonance of nterstitial Na atoms in NaCl are estimated. The results are qualitatively different from those obtained using the De Boer model of an F-centre. M.G.Priestley

539.2 : 535.343

8853. A TEST OF THE INTERPRETATION OF CERTAIN OPTICAL ABSORPTION BANDS IN FLUORITE IRRADIATED WITH X-RAYS.

Y.Allain.

C.R. Acad. Sci. (Paris), Vol. 248, No. 16, 2318-20 (April 20, 1959). In French.

The optical absorption of fluorite irradiated with X-rays (a) in its natural state, (b) after it has been heated in an atmosphere of calcium vapour, has been investigated between 3000 A and 7000 A. The band at 5750 A is observed to increase in intensity for fluorite heated in an atmosphere of calcium vapour and the band is tentatively attributed to fluorine ion vacancies. R.D.Hudson

539.2 : 535 : 537

8854. OPTICAL AND ELECTRICAL PROPERTIES OF SINGLE CRYSTALS OF TRI-p-METHOXY PHENYL METHYL PERCHLORATE AND TRIPHENYL METHYL AZIDE.

B.L.Evans and A.D.Yoffe.

J. chem. Phys., Vol. 30, No. 6, 1437-42 (June, 1959).

The measurements included the absorption spectra, photoconduction behaviour, low-frequency dielectric constants, and refractive indices. In the case of tri-p-methoxy phenyl methyl perchlorate, where the electron affinity of the acid radical is high, he solid is ionic and an estimate has been made of the energy required to raise an electron from the full band to the conduction band. The properties of triphenyl methyl azide are consistent with a covalent type solid. The stability of these compounds is considered n outline.

539.2 : 535.371

8855. PHASE EQUILIBRIA AND FLUORESCENCE IN THE SYSTEM $Zn(PO_3)_2-Mg(PO_3)_2$.

J.F.Sarver and F.A.Hummel.

J. Electrochem. Soc., Vol. 106, No. 6, 500-4 (June, 1959).

The equilibrium diagram for the system $Zn(PO_3)_2-Mg(PO_3)_2$ was established as a solid solution type by quenching and solid-state methods. About 10 mole % $Mg(PO_3)_2$ was found soluble in β-$Zn(PO_3)_2$ at 850° C, but less than 2 mole % was soluble in α-$Zn(PO_3)_2$ at 650° C. Solid solution of $Zn(PO_3)_2$ in $Mg(PO_3)_2$ was extensive, ranging from approximately 35 to 100 mole % $Mg(PO_3)_2$. The cathodoluminescence of compositions in the three solid-solution series was examined for peak emission and brightness when activated with manganese. A shift in the position of the emission peak from 6000 to 6200 A in the magnesium metaphosphate solid-solution series has been interpreted in terms of the difference in influence between magnesium and zinc ions on the polarizability of oxygen ions in the neighbourhood of the manganese activator.

539.2 : 535.37

8856. TRANSIENT PROCESSES IN THE OPTICAL BLEACHING OF F AND F' CENTERS IN POTASSIUM CHLORIDE.

A.R.Reinberg and L.I.Grossweiner.

J. chem. Phys., Vol. 30, No. 6, 1616-17 (June, 1956).

A xenon flash tube is used to provide short duration bleaching light pulses. Bleaching pulses in the F band cause a rapid decrease in F band absorption followed by a slow recovery (90% complete in 0.2 sec) which is insensitive to temperature. For bleaching pulses at wavelengths above 600 mμ a rapid increase in the F band occurs followed by a return to original transmission in the dark in about the same time but is not observed above −20°C. The recovery is a first order process. Conversion of F' to F centres would account for the latter effect. The F band irradiation is assumed to eject F electrons and to be followed by their slow retrapping.

G.F.J.Garlick

539.2

8857. THE EFFECT OF PRESSURE ON COLOR CENTERS IN ALKALI HALIDE CRYSTALS.

W.G.Maisch and H.G.Drickamer.

J. Phys. Chem. Solids, Vol. 5, No. 4, 328-36 (1958).

The absorption spectra of both X-irradiated and additively coloured alkali halides have been studied under pressure up to 50 000 atm. These experiments were conducted at room temperature and, with a few exceptions, only those bands occurring in or near the visible region of the spectrum were studied. Frequency shifts and bleaching effects, the latter induced both by radiation and by plastic deformation, were observed. An apparently new band, intimately related to the F centre and appearing at the expense of the F band, has been studied. Several related experiments were run at 1 atm. It has been shown that atmospheric oxidation is one of the mechanisms responsible for the bleaching of plastically deformed crystals.

539.2

8858. THE ELECTRONIC STRUCTURE OF AN H-CENTER.

W.Känzig and T.O.Woodruff.

J. Phys. Chem. Solids, Vol. 9, No. 1, 70-92 (Jan., 1959).

The electronic structure of a new type of colour centre, which is produced in KCl, KBr, and LiF crystals by X-irradiation at low temperatures, has been determined by electron-spin-resonance experiments. Crudely, this centre can be described as a halogen$_2^-$ molecule-ion located in a halide-ion vacancy. The unpaired electron interacts strongly with the two nuclei of the molecule-ion and weakly with two more halogen nuclei. All four nuclei lie in a straight row along a [110] axis. This paramagnetic centre may be identical with the centre that gives rise to the optical H-band, since in KCl it has the same production, bleaching, and symmetry characteristics.

539.2

8859. HYPERFINE INTERACTIONS IN F-CENTER PARAMAGNETIC-RESONANCE SPECTRA IN LiF AND NaF.

G.J.Wolga and M.W.P.Strandberg.

J. Phys. Chem. Solids, Vol. 9, No. 3-4, 309-19 (March, 1959).

The method of paramagnetic resonance is used to study the magnetic-energy levels of F-centers in LiF and NaF. The microwave absorption spectra show a set of nearly resolved transitions; each crystal has an odd number of almost equally spaced lines symmetrically located about a central resonance. The spectra are found to be isotropic with respect to relative orientation of the 100-axis and the applied magnetic field. The scalar magnetic hyperfine interaction and the spectroscopic splitting factor are determined from experimental data. The experimental results are interpreted on the basis of the de Boer model of the F-centre, and determine the probability density of the F-electron wave function at the sites of the nearest-neighbour nuclei. The line breadth of the inhomogeneously broadened spin packets is obtained from the dependence of the spectrum on the ratio of line width to hyperfine interaction. The packet breadth is attributed to unresolved hyperfine interaction with further nuclei, and yields an estimate of the scalar hyperfine interaction with the next-nearest-neighbour nuclei. The observed spectroscopic splitting factors, corrected for the hyperfine interaction shift, are found to be smaller than the free-electron value. This difference is attributed to spin—orbit coupling with excited states of higher orbital angular momentum, and it yields an estimate for the expectation value of $(1/r^3)$. The predictions of the theory of inhomogeneous broadening on the dependence of the absorption upon microwave power are confirmed.

539.2 : 538.27

8860. A THEORY OF ELECTRON-SPIN RESONANCE OF F-CENTRES IN IONIC CRYSTALS (CONTINUOUS MODEL OF AN F-CENTRE — "SMOOTHED FUNCTIONS").

M.F.Deĭgen and L.A.Shul'man.

Optika i Spektrosk., Vol. 3, No. 1, 21-8 (July, 1957). In Russian.

The paper discusses in relativistic approximation (Darwin's method) and non-relativistic approximation (Pauli's method) the interaction of a localized s-electron with the nuclear magnetic moment, displaced from the centre of symmetry of the electron wave-function. Hyperfine structure of the energy levels of the electron is obtained. Calculation is generalized to the case of interaction with several nuclear magnetic moments. The results obtained are used to discuss electron spin resonance, absorption of radiowaves by F-centres using "smoothed" electron wave-functions and to estimate the maximum width of the spin-resonance absorption band.

A.Tybulewicz

539.2 : 538.27

PARAMAGNETIC RESONANCE ABSORPTION OF A V CENTRE IN LiF. See Abstr. 8341

539.2 : 535.343

8861. CONCERNING THE STRUCTURE OF THE HOLE ZONE OF TELLURIUM. L.I.Korovin and Yu.A.Firsov.

Zh. tekh. Fiz., Vol. 28, No. 11, 2417-27 (1958). In Russian.

Stimulated by the observations of Caldwell and Fan [Phys. Rev., Vol. 94, No. 5, 1427 (June 1, 1954)] and of Nussbaum (Abstr. 6612 of 1954) on the polarization dependence of the infrared absorption of Te, a theoretical investigation was made of the absorption in uniaxial crystals. The theory of groups is used to show that the hole band has either one non-degenerate extremum at $k = 0$ or two non-degenerate extrema along the symmetry axis k_z. The further experimental evidence required to decide between these alternatives is discussed.

K.F.Hulme

539.2 : 535.37 : 537.533

COLOUR CENTRES IN NaCl. See Abstr. 8205

539.21

8862. THE EFFECT OF X-RAYS ON COLOURED PLEXIGLASS. H.Hinrichs.

Atomkernenergie, Vol. 2, No. 2, 41-5 (Feb., 1957). In German.

X-irradiation causes "Red 2" Plexiglass to become opaque. The effect depends linearly on dose above 10^5 r and fades with time after irradiation (half-life 300 h at 6500 A after 5×10^5 r). This fading did not occur in vacuo. The effects are discussed in terms of oxygen diffusion through the lattice.

J.R.Mallard

539.21 : 539.1.07

8863. ON THE COLORATION OF GLASSES BY IONIZING RADIATION. I.Kügler.

Atomkernenergie, Vol. 4, No. 2, 67-72 (Feb., 1959). In German.

An investigation is made of the absorption spectra after irradiation of various glasses, especially those with high coloration sensitivity. The effect of cerium in silicate and phosphate glasses is specifically studied and specimens considered for application in dosimetry.

G.F.J.Garlick

539.21 : 537.312.5

8864. ON THE IRRADIATION OF PHOTOCONDUCTING SINGLE CRYSTALS OF CADMIUM SULPHIDE BY 1.4 MeV PROTONS. R.Barjon, C.Brachet, M.Lambert, M.Martineau and J.Schmouker.

C.R. Acad. Sci. (Paris), Vol. 248, No. 1, 83-6 (Jan. 5, 1959). In French.

The irradiation gives rise to three effects: green luminescence and induced electrical conductivity, both persisting only during the irradiation, and permanent changes of photoconducting properties. These last include enhanced photoconductivity with white light, and alteration in the spectral response in the visible region.

B.T.M.Willis

539.21 : 537.533

8865. DISSOCIATION OF SOLID SrO BY IMPACT OF SLOW ELECTRONS. G.E.Moore.

J. appl. Phys., Vol. 30, No. 7, 1086-100 (July, 1959).

Dissociation of solid SrO impact of electrons having energy below 400 V was measured by a mass spectrometer method. Positively and negatively charged dissociation products were observed with equal sensitivity; no uncharged products were observed with an arrangement having poorer sensitivity. The fundamental dissociation products are Sr^+, Sr^{++}, and O^+ with essentially no O^-. Surface impurities such as CO, Cl, F, and H were also abundant. The only source of chlorine found was an impurity in the original $SrCO_3$, of about 1 part in 10^5. However, its abundance in the ion current is about equal to that of oxygen, and the yields on Cl^+ and Cl^- are about equal. All particles must come essentially only from the surface layers. Yields of Sr^+ and Sr^{++} increase with the square of electron density; yields of O^+, Cl^+, and Cl^- increase, respectively, with the 1.5, 1.0, and 1.0 power of electron current density. The process is quite inefficient, the impact of 10^7 electrons giving about 1 fundamental dissociation product for 20 to 30 mA per cm^2 of bombarding current. Yields are independent of electron energy from slightly above threshold to beyond 200 V, above which they decline slowly. Yields increase slightly with temperature, corresponding to activation energies of a few tenths of a volt. At least some of the chlorine on the surface probably exists in the uncharged form; threshold energies are too low to convert a Cl^- on the surface to a Cl^+ in the vacuum. Removal of O^+, Sr^+, and Sr^+ ions is discussed in terms of a crystal composed of singly charged Sr^+ and O^- ions; a process involving two incoming electrons in rapid succession on a minute area is apparently required for remo al of an O^+, Sr^+, or Sr^{++} ion.

539.

8866. EFFECT OF ELECTRON BOMBARDMENT ON SODIUM CHLORIDE. S.Yoshida and T.Ikeda.

J. Phys. Soc. Japan, Vol. 12, No. 12, 1422 (Dec., 1957).

This note concerns the formation of colloidal sodium in sodiu chloride single crystals by bombardment with 7-20 keV electrons. Below 13 keV the specimens were coloured yellow, and showed distinct F and M absorption bands. Above 16 keV blue coloration also developed, and at 20 keV the specimens acquired a deep blue colour, with a strong absorption band at 590 mμ and a weak one at 390 mμ. The latter effect also occurred at 13 keV when the curren density was increased from 40 μA/cm^2 to 70 μA/cm^2, and at 7 keV, 40 μA/cm^2 when the specimen temperature was raised to 150° C. The blue band was stable at room temperature, but shifted to 565 mμ on heating to 390° C, and the crystal was completely bleach at 450° C. If the specimens were heated during bombardment, the band shifted to longer wavelengths and became less sharp. The 590 mμ band was identified as due to colloidal sodium.

J.B.Birk

539.

8867. EFFECT OF NEUTRON IRRADIATION ON THERMALLY AND MECHANICALLY INDUCED NONEQUILIBRIUM STATES IN AuCu. R.L.McCollum and G.Allen.

J. appl. Phys., Vol. 30, No. 7, 1105-8 (July, 1959).

Studies have been made of the effect of neutron irradiation on the resistivity and magnetoresistivity of the alloy AuCu when subjected to various pre-irradiation thermal and mechanical treatments. The specimens were exposed to estimated fast neutron flu up to 7.3×10^{18} neutrons/cm^2 in the Brookhaven pile. In the case of thermally disordered specimens, the effect of the irradiation was to decrease the resistivity in completely disordered states an to increase the resistivity in completely ordered states; viz., there was some tendency for specimens to reach intermediate degrees o order. The effect on mechanically disordered specimens was to increase the resistivity in all cases. The irradiation effected a large percentage change in the coefficient of magnetoresistivity tha in the resistivity.

539.

8868. RECOIL REACTIONS WITH HIGH INTENSITY SLOW NEUTRON SOURCES. III. THE RADIATION DECOMPOSITION OF CRYSTALLINE $KBrO_3$. G.E.Boyd and J.W.Cobble.

J. phys. Chem., Vol. 63, No. 6, 919-25 (June, 1959).

For Pt II, see Abstr. 5399 (1952). The relative contributions energetic neutrons, γ- and β-rays to the radiation decomposition o crystalline $KBrO_3$ in the Oak Ridge graphite pile were determined as approximately 20, 40 and 40%, respectively. Decomposition yields ("G"-values) for β-rays and pile γ-rays were 1.0 ± 0.1 mol cule per 100 eV energy absorbed, while for energetic neutrons yields varying from 23 to 30, dependent on neutron energy, were found. The much greater efficiency for decomposition by fast neutrons was attributed to the mechanism whereby these particles transfer energy to bromate radicals.

539.

8869. CRYSTALLINITY CHANGES IN IRRADIATED POLYETHYLENES. A.Charlesby and L.Callaghan.

J. Phys. Chem. Solids, Vol. 4, No. 4, 306-14 (1958).

The destruction of crystallites in polyethylene exposed to radiation has been followed by measurements of specific volume. For equal energy absorption, pile radiation is far more effective than electrons in disrupting crystallites, possibly because of the interaction of fast neutrons with the hydrogen atoms. The reductio in crystal size can be readily followed by using the concept of equivalent paraffin size outlined in a previous paper. The larger crystals are more readily destroyed in both low- and high-density polyethylene. An extrapolation of the specific-volume temperatur

ve to 0°K gives an approximately constant value v_0 for the
cific volume, whether the material be amorphous, lightly cross-
ed (as in a rubber), highly crosslinked (as in a glass-like
e), or crystalline. The specific volume v at any temperature
an be written in the form

$$(v - v_0)(P + P_0 + P_r r) = RT/M,$$

re P is the external pressure, P_0 the internal pressure, P_r r
he equivalent of an internal pressure arising from the cross-
s produced by a radiation dose r, R is the gas constant and M
unit molecular weight (28 for C_2H_4 in polyethylene).

539.21

). THE QUESTION OF RADIATION-INDUCED PHASE
ANGES. U.Gonser and B.Okkerse.
Phys. Chem. Solids, Vol. 7, No. 1, 55-7 (Oct., 1958).
Radiation-induced phase changes can give valuable information
ut the nature of thermal-spike regions. Recent experiments
gest the following classification: (1) If dV/dT is always positive,
n at the transformation point, the thermal spike is a region con-
ing Frenkel pairs or many displaced atoms, as in the "displace-
t spike" of Brinkman (Abstr. 9437 of 1954); (2) If dV/dT has an
maly, corresponding to an increase of density due to the forma-
of a more closely packed phase, one may expect the more dense
se to be produced in a "structure spike". In the latter case the
pressure which a thermal spike exerts on the surrounding matrix
n important factor in creating the high-temperature phase.

539.21

1. A STATISTICAL THEORY OF LATTICE DAMAGE IN
LIDS IRRADIATED BY HIGH-ENERGY PARTICLES.
.Pál and G.Németh.
vo Cimento, Vol. 12, No. 4, 293-309 (May 16, 1959).
The distribution function for the number of lattice displacements
olids irradiated by high-energy particles has been determined by
ans of exact methods of the theory of probability. The generating
ction of the distribution function yields equations determining the
rage number of displacements and their dispersion. These equa-
s have been solved on the assumption that the primary bombard-
particles are neutrons and that the collision phenomena between
splaced atom and an atom vibrating in the lattice may be regard-
as collisions between perfectly rigid spheres. It has been found
the variance of the number of lattice displacements is larger
the variance of Poisson's distribution for the case of irradiation
ission neutrons.

539.21

2. ON THE EFFECT OF AN ACTIVATOR ON NON-
TIVATOR LEVELS OF ELECTRON CAPTURE IN ALKALI-
LIDE PHOSPHORS. I.A.Parfianovich.
ika i Spektrosk., Vol. 4, No. 2, 253-6 (Feb., 1958). In Russian.
lish summary : PB141047T-1, obtainable from Office of
hnical Services, U.S. Dept. of Commerce, Washington, D.C.,
.A.
Pure NaCl crystals and ones activated with Ni and Cu were
adiated with X-rays at room temperature and the absorption
ctra were studied. The F-centre density increases in
Cl : Ni and NaCl : Cu with increase in activator concentration.
M-absorption band is not affected by Ni, but is depressed by
In NaCl : Cu and NaCl : Ni illumination with F-band light
troys F-centres without formation of M- or F'-centres. The
lanation of the effect of the activator is the formation of hole-
V-centres, as well as electron-centres by the X-rays. The
ner rate of formation of electron centres in activated NaCl is due to
higher probability of capture of free holes. The faster optical
truction of F-centres in activated crystals suggests the presence
ole centres which have larger cross-sections for electron
ture than V-centres in pure NaCl. J.B.Birks

539.21 : 536.631

EFFECT OF NEUTRON IRRADIATION ON THE SPECIFIC
AT OF GRAPHITE. See Abstr. 8052

STRUCTURE OF SOLIDS

539.211

8873. STABILITY OF POLISHED SURFACES. I.Šolc.
Czech. J. Phys., Vol. 7, No. 5, 628-30 (1957). In German.

Observations on a freshly polished quartz surface (by microscopy, acoustic impulses, and change in resonance frequency) show that fine particles are emitted. The number emitted decreases rapidly with time but changes can be observed for several hours. Porcelain, glasses, etc., exhibit this effect but metals and several simple crystals do not. J.M.Hough

539.211

8874. CONTRIBUTION OF SURFACE DISTORTION TO THE SURFACE ENERGY OF ALKALI HALIDE CRYSTALS.
G.C.Benson, P.Balk and P.White.
J. chem. Phys., Vol. 31, No. 1, 109-15 (July, 1959).

The distortion of the {100} face of the NaCl-type lattice and its influence on the surface energy were considered using a model in which the ions of the first crystal layer are allowed to displace separately and to polarize. van der Waals terms were included in the potential function in order to make the treatment consistent with existing classical calculations on the surface energy of the undistorted surface. The configurations of lowest energy and the corresponding surface energy corrections have been computed for all NaCl-type alkali halides except LiF, for which compound no stable minimum could be found. A short discussion on the approximational aspects of the calculations is given.

539.213 : 539.19

STRUCTURE OF VITREOUS $B_2O_3 \cdot \frac{1}{3}H_2O$. See Abstr. 8751

539.215

8875. ON THE DETERMINATION OF PREFERRED ORIENTATIONS. C.G.Dunn.
J. appl. Phys., Vol. 30, No. 6, 850-7 (June, 1959).

The orientations of individual grains in cold-rolled and annealed silicon–iron strip were obtained for a single-component texture and a multiple-component texture to determine (1) the preferred orientations in the two textures and (2) some information on the nature of formation of the textures. A set of three axis density figures and a (100) pole density figure were synthesized for the multicomponent texture. It is concluded from the figures that the axis density figures give more information about the components present in the texture than a (100) pole figure does. It is also concluded that oriented nucleation is important in the development of the textures.

539.215.2 : 538.2

8876. SYNTHESIS OF A (110) [001] TYPE TORQUE CURVE IN SILICON IRON. C.G.Dunn and J.L.Walter.
J. appl. Phys., Vol. 30, No. 7, 1067-72 (July, 1959).

The orientations and sizes of all the grains in a polycrystalline disk specimen of high-purity 3.25% silicon iron are measured to determine a calculated magnetic torque curve and the texture of the specimen. The torque results agree with the experimentally determined values. The curves approximate a (110) [001] single crystal torque curve, which is reduced about 75%, and thus indicate a possible texture consisting of about 25% (110) [001] and 75% random. The true texture obtained from the orientation data is found to have more than ten components, none of which is (110) [001]. Illustrations showing how a (110) [001] type torque curve may be synthesized from non-(110) [001] type components in the texture are given.

539.215.2 : 534.23

8877. THE USE OF ULTRASONIC WAVES IN INVESTIGATING THE STRUCTURE OF STEELS. L.G.Merkurlov.
Zh. tekh. Fiz., Vol. 27, No. 6, 1386-91 (June, 1957). In Russian.
English translation in : Soviet Physics — Technical Physics (New York), Vol. 2, No. 6, 1282-6 (June, 1957).

The attenuation coefficient for longitudinal ultrasonic waves was determined for three steels of differing carbon content after they had been given different heat-treatments. It was found that in the frequency range above 5 Mc/s the coefficient increased rapidly with frequency and also increased with grain-size. Average grain-size can be measured with some degree of accuracy by this method. A chrome—nickel steel was also used to see if attenuation measurements could reveal incomplete tempering in a specimen. Above 15 Mc/s the attenuation was appreciably greater in specimens with an untempered structure than in fully tempered ones, though the average grain-size was the same for both types of specimen.

A.E.Kay

539.216 : 535.345

USE OF FIBRE SPECIMENS FOR INFRARED ABSORPTION MEASUREMENTS. See Abstr. 7969

539.217

8878. ON THE KIRKENDALL EFFECT IN THE HEXAGONAL CLOSE-PACKED PHASE OF CADMIUM AND MERCURY.

D.H.Killpatrick and R.W.Balluffi.

J. appl. Phys,, Vol. 30, No. 3, 449-50 (March, 1959).

Results are given of a study of the Kirkendall effect and associated effects which are consistent with the operation of a vacancy mechanism in Cd/Cd + 37% Hg diffusion couples.

R.F.Peart

539.217

8879. DIFFUSION OF COPPER IN CADMIUM SULFIDE CRYSTALS.

R.L.Clarke.

J. appl. Phys., Vol. 30, No. 7, 957-60 (July, 1959).

Copper was diffused in cadmium sulphide single crystals to determine diffusion coefficients using the radioactive tracer sectioning technique. Over the temperature range of 450°-750°C, the relationship between temperature and diffusion coefficient was found to be $D = 1.5 \times 10^{-3} e^{-17600/RT}$ cm^2/sec for diffusion perpendicular to the C axis. For diffusion parallel to the C axis, the frequency factor and activation energy were found to be within the experimental accuracy of the corresponding values for perpendicular diffusion. There appears to be no appreciable diffusion anisotropy. Observed surface diffusion was a complicating factor in obtaining data on volume diffusion.

539.217 : 537.533

8880. DIFFUSION OF ACTIVATOR OF CATHODE SLEEVE.

H.Mizuno.

J. Phys. Soc. Japan, Vol. 12, No. 11, 1315 (Nov., 1957).

The diffusion coefficient of magnesium in nickel was determined by an evaporation experiment. The tests were repeated for alloys containing various percentages of manganese and it was found that the diffusion coefficient of Mg depended on the Mn concentration, being considerably less for Mn concentrations over about 6%.

A.H.W.Beck

539.217 : 537.311.33

8881. DIFFUSION, SOLUBILITY, AND ELECTRICAL BEHAVIOR OF COPPER IN GALLIUM ARSENIDE.

C.S.Fuller and J.M.Whelan.

J. Phys. Chem. Solids, Vol. 6, No. 2-3, 173-7 (Aug., 1958).

Copper diffuses into GaAs single crystals at rates comparable to those found for copper in silicon and germanium. As with germanium, the diffusion appears to follow the dissociative mechanism. Autoradiographic evidence for this is presented. It is shown that the diffusion process requires both interstitial and substitutional roles for copper. The solubility of copper in single crystals of GaAs has been determined from 700° to 1160°C by means of Cu^{64}. Copper is found to be an acceptor in GaAs, with a probable ionization energy of 0.063 eV. Deeper-lying levels have been found in GaAs containing copper, but their identification is obscured by compensating impurities in the original material.

539.217

8882. THE DIFFUSION AND PRECIPITATION OF INDIUM IN ZINC OXIDE.

D.G.Thomas.

J. Phys. Chem. Solids, Vol. 9, No. 1, 31-42 (Jan., 1959).

Indium has been dissolved in ZnO single crystals by coating crystals with a solution of indium nitrate and firing at temperatures between 800 and 1300°C. The diffusion rate may be obtained by following the increase of conductivity produced by the indium as a function of time. The conductivity of a crystal supersaturated with respect to indium falls at a rate which indicates internal precipitation of a new phase occurring along lines. These lines are tentatively identified as dislocations, and the results, interpreted according to a treatment given by Frisch, indicate that crystals grown in the laboratory have a dislocation density near 10^7 cm^{-2}, while some commercial crystals have a density near 10^8 cm^{-2}. The diffusional behaviour around the new phase is highly reproducible and in air gives:

$$D \approx 2.5 \times 10^2 \exp\left(-\frac{3.16}{kT}\right) \mathrm{cm}^2/\mathrm{sec}.$$

D is found to increase with increasing oxygen pressure with $D \propto P_{O_2}{}^{1/4}$, indicating that zinc vacancies control diffusion. The solubility of indium varies approximately as $P_{O_2}{}^{-1/8}$, as is to be expected if the indium dissolves in ZnO without being associated with a comparable concentration of vacancies. Hall-effect measurements give solubilities in the range 10^{17} to 2×10^{19} cm^{-3} and show that the precipitated phase materially lowers the electron mobility.

539.217

8883. ON THE DYNAMICAL THEORY OF DIFFUSION IN CRYSTALS. II. PRESSURE DEPENDENCE OF THE SELF-DIFFUSION CONSTANT.

S.A.Rice and N.H.Nachtrieb.

J. chem. Phys., Vol. 31, No. 1, 139-45 (July, 1959).

For Pt I see Abstr. 6304 of 1959. A dynamical theory of diffusion developed previously is extended to the study of the pressure dependence of the self-diffusion constant. It is shown that in the limit of low pressures there exists a law of corresponding states of the form

$$\ln D \propto T_m/T$$

where T_m is the melting temperature of the crystal. It is further shown that the temperature and pressure derivatives of the self-diffusion coefficient are related as

$$\Delta H^\dagger = (\Delta H_m/\Delta V_m)\Delta V^\dagger$$

with a dagger referring to activated quantities and a subscript m to fusion parameters. Application of the theory is made to Na and Pb. For Pb, the computed heat of activation is 24 300 cal to be compared with the experimental value of 24 210 cal.

539.217

8884. METHODS OF STUDYING SELF-DIFFUSION IN METALS BY MEANS OF RADIO-ISOTOPES.

C.Leymonie and P.Lacombe.

Internat. J. appl. Radiation and Isotopes, Vol. 5, No. 3, 175-96 (May, 1959). In French.

Deals with the different methods in use at present for studying both general self-diffusion and inter-granular self-diffusion. There is now a fairly wide choice of methods for general self-diffusion; that of examining sections is undoubtedly the most accurate, but in practice it is limited to the measurement of diffusion coefficients greater than 10^{-11}. For smaller values, absorption methods must be employed; in that case, the choice of method for solving a given problem depends above all on the radiation characteristics of the radioactive isotopes. The various absorption methods which have been used recently are examined, each one being illustrated by a specific example; particular emphasis has been laid on those methods in which careful choice of the geometric parameters eliminates the need to know the absorption characteristics of the radiations. The choice of methods for studying intergranular self-diffusion is more limited; comparison of the values of concentration in the grain boundaries given by the theories of Fisher and of Whipple, respectively, is given prominence, and conditions are defined under which, by a simple application of Fisher's formula, the sectional method may be used to examine intergranular diffusion.

539.217

8885. SELF DIFFUSION OF IRON IN IRON SILICATE MELT.

Ling Yang, C-Y.Chien and G.Derge.

J. chem. Phys., Vol. 30, No. 6, 1627 (June, 1959).

Measurements were made of the diffusion of Fe in FeO—SiO_2 melts containing 61% by weight of FeO by a radiotracer technique. From values of D_{Fe} at 1250°, 1275° and 1304°C an activation energy of "about 40 kcals/mole" was obtained.

R.F.Peart

539.217

8886. EFFECT OF PRESSURE ON SELF-DIFFUSION IN LEAD.

N.H.Nachtrieb, H.A.Resing and S.A.Rice.

J. chem. Phys., Vol. 31, No. 1, 135-8 (July, 1959).

Data are presented for the self-diffusion of lead as a function of temperature from 174° to 322°C and for pressures from 1-8000 atm. The decrease in the self-diffusion coefficient with ressure follows a relationship of the form

$$(d\ln D)/d\xi = -(1/RT_0)\left(Q_0 - \frac{\Delta V_{act}}{dT_m/dP}\right),$$

here $\xi = T_m/T$, T_0 and Q_0 are the normal melting point and the
ero pressure activation energy, respectively, and ΔV_{act} is the
ctivation volume. To first order the derivative is constant, devi-
ions arising at high pressure because of the pressure dependence
dT_m/dP. Several relationships are derived from thermodynamic
onsiderations of the activated state, and are shown to be valid ex-
erimentally: (1) $\Delta H_{act} = bRt_m$, with b = 20.7, and (2) $\Delta H_{act} =$
$H_m \cdot (\Delta V_{act}/\Delta V_m)$, where ΔH_m and ΔV_m are the latent heat and
olume change on fusion, respectively.

539.217 : 537.311.33

87. INTERDIFFUSION IN BINARY IONIC SEMICONDUCTORS.
.F.Brebrick.
appl. Phys., Vol. 30, No. 6, 811-15 (June, 1959).

Interdiffusion in a nondegenerate, exhaustion range, binary
nic semiconductor is investigated using the recently improved
eory for the concentrations of defects in crystals and Wagner's
henomenological flow equation. The composition dependence of the
terdiffusion constant is found to be determined by the ratio of the
n jump frequencies, the Schottky constant, and the intrinsic concen-
ation of conduction band electrons. The removal of the restriction
an exhaustion range semiconductor and the replacement of the
sic assumption of local electroneutrality are discussed.

539.217 : 539.27

88. ELECTRON METALLOGRAPHIC EVIDENCE OF DIFFU-
ON OF HYDROGEN THROUGH TIN PLATE CONTAINERS.
.Lanterman.
appl. Phys., Vol. 30, No. 7, 1084-6 (July, 1959).

Electron metallographs evidenced rupture and blistering of the
xterior tin surface of containers which had failed prematurely due
excessive hydrogen formation by corrosion processes within the
ontainer when packed with grapefruit juice. The enlargement of
rain boundaries of the base steel of tin plate due to hydrogen diffu-
on was illustrated.

539.217

89. USE OF RADIOACTIVE ISOTOPES IN INVESTIGATIONS
F THE DIFFUSION AND THERMODYNAMIC CHARACTERISTICS
F SOLID SOLUTIONS. A.A.Zhouhovitzky.
ternat. J. appl. Radiation and Isotopes, Vol. 5, No. 3, 159-74
lay, 1959).

New techniques are discussed. Absorption methods (the "thick
yer" and the "thin layer" methods) permit the determination of
ffusion coefficients whereby measurements of radiation absorption
e not necessary. The impression method is rapid. The technique
r determination of thermodynamic characteristics is based on ex-
hange rate measurements. A non-isothermic method for the deter-
ination of diffusion characteristics and new techniques for measure-
ents of the heat of dilution by the solubility to temperature ratio
ave been set forth during the last years. All methods were tested
a series of diffusion and thermodynamic measurements.

539.217

90. DIFFUSION OF RUTHENIUM IN SINGLE CRYSTALS OF
LVER. C.B.Pierce and D.Lazarus.
hys. Rev., Vol. 114, No. 3, 686-7 (May 1, 1959).

The diffusion coefficient of ruthenium in monocrystalline silver
as measured over the temperature range 793° to 945°C, using
u^{103} and Ru^{106} tracers, and a sectioning technique. The results may
expressed by an Arrhenius relation as $D = (180 \pm 70)\exp[$
$-(65\,800 \pm 1000)/RT]\,cm^2/sec$. The present result is consistent
ith earlier theoretical models, unlike the results obtained by
ackliet for Fe in Cu.

539.217.5 : 533.17

MEASUREMENT OF THE EMISSION OF NITROGEN DIS-
OLVED IN PURE IRON INTO A VACUUM. See Abstr. 7849

539.219

91. THEORY OF ORDER IN Fe_3Al ALLOY. K.F.Wojciechowski.
cta phys. Polon., Vol. 18, No. 1, 15-20 (1959).

A statistical theory of order–disorder transitions in the Fe_3Al
lloys is presented which enables one to take into account the inter-
ctions of atoms from farther neighbourhood and thus to determine
ore accurately the transition temperature from order to disorder.
is shown that the interaction energy of the third neighbourhood is
pproximately $\frac{1}{2}$ of the interaction energy of the second one.

539.219

8892. ON THE ORDER–DISORDER TRANSITION TEMPERATURE IN n-COMPONENT ALLOYS.

S.Świerczkowski and K.F.Wojciechowski.
Bull. Acad. Polon. Sci. Ser. Sci. math. astron. phys., Vol. 6, No. 9, 585-7 (1958).

A theoretical treatment is given which relates the transition temperature in a multicomponent alloy to long-range order and thermodynamic parameters. R.F.Peart

539.219

8893. STRUCTURAL EFFECTS OF THE DIFFUSIONLESS PHASE TRANSFORMATIONS IN Au–Cd ALLOYS. H.K.Birnbaum.

J. appl. Phys., Vol. 29, No. 12, 1773-4 (Dec., 1958).

The author reports the preliminary results of an investigation of the effects of these transformations in Au–Cd alloys on the crystal perfection. The integral breadth of the β(CsCl) phase 110 reflection was measured after various numbers of the transformation cycles. A broadening was observed but sufficient data to determine its cause are not yet available. It is considered that the structural effects of the transformation must be associated with the nature of the interface and its passage through the crystal.

M.G.Priestley

539.219

8894. THE SOLUBILITY OF OXYGEN IN SILICON.

H.J.Hrostowski and R.H.Kaiser.
J. Phys. Chem. Solids, Vol. 9, No. 3-4, 214-16 (March, 1959).

The intensity of the fine structure of the 1100 cm^{-1} silicon-oxygen absorption at 4.2°K has been used to determine the temperature-dependence of the concentration of oxygen in solid solution. Above 1000°C the logarithm of this concentration is a linear function of the reciprocal of the absolute temperature, and the heat of the precipitation reaction is 22 ± 2 kcal/mole.

539.219

8895. ON THE TEMPERATURE-DEPENDENCE OF THE DISTRIBUTION COEFFICIENT. THE SOLID SOLUBILITIES OF TIN IN SILICON AND GERMANIUM.

F.A.Trumbore, C.R.Isenberg and E.M.Porbansky.
J. Phys. Chem. Solids, Vol. 9, No. 1, 60-9 (Jan., 1959).

The solid solubility of tin in silicon has been determined in the range from 800°C to the melting point of silicon, using crystal-pulling and thermal-gradient crystallization techniques. The distribution coefficient, k, of tin in silicon falls from 0.016 at the melting point of silicon to about 6.5×10^{-4} at 800°C. Earlier work on the tin-germanium system has also been extended. The form of the temperature-dependence of k is similar for both systems and does not fit into the correlation recently proposed by Hall [J. Phys. Chem. Solids, Vol. 3, 63 (1957)]. For these two systems the observed temperature-dependence of k can be explained as being due in a large measure to departures from ideality in the liquid state. Binding energies of tin in germanium and silicon calculated from the solid-solubility data compare favourably with binding energies calculated using Allen's reciprocal mean postulate for covalent bond energies (Abstr. 1296 of 1958).

539.219

8896. THE INFLUENCE OF SHOCK DEFORMATION ON THE FORMATION OF MARTENSITE PLATES. A.Mašín and D.Tlustá.

Czech. J. Phys., Vol. 7, No. 1, 122-3 (1957).

Describes experimental results obtained on striking an iron bar with an oscillating hammer. J.M.Hough

539.219 : 538.2

8897. CONSTITUTION AND MAGNETIC PROPERTIES OF IRON-RICH IRON–ALUMINUM ALLOYS. A.Taylor and R.M.Jones.

J. Phys. Chem. Solids, Vol. 6, No. 1, 16-37 (July, 1958).

The constitution of high-purity iron–aluminium alloys over the composition range 0-62% aluminium has been investigated, primarily by X-ray diffraction methods. New lattice-parameter data were obtained which differ significantly from the classical results obtained by Bradley and Jay (1932). Diffraction patterns taken at elevated temperatures have shown that the phase diagram needs correction in the region of Fe_3Al, along with the further addition of a sloping transformation boundary beyond 18% aluminium. According to the results of this investigation, alloys in the composition range 18-33% aluminium undergo a classical phase change and, on heating, pass successively from the Fe_3Al type of atomic ordering to the FeAl type. As the temperature is still further raised, anti-phase nuclei form, and finally the atomic arrangement becomes either a random one or one possessing short-range order. Alloys containing more than 37.5 atomic per cent aluminium retain the FeAl type of order all the way up to the melting point. Anomalies in the lattice parameters, magnetic behaviour, and thermal expansion of alloys in the region of Fe_3Al can be interpreted in the light of these structural changes. It has been found that cold working alloys containing aluminium in excess of 20 atomic per cent increases the magnetic saturation moment and also the lattice parameter. In the region of Fe_2Al, the resulting increase in volume on cold working approaches 3%, and FeAl, which is virtually non-magnetic at absolute zero, becomes appreciably ferromagnetic after severe grinding. A ferromagnetic face-centred cubic phase structure, probably based on Fe_3AlC, is found associated with alloys lying in the approximate composition range 10-33 atomic per cent aluminium. Lattice-parameter measurements indicate the possibility of an epitaxial relationship between the body-centred cubic matrix and the face-centred structure. There are indications that this "extra" phase structure undergoes an order—disorder transformation. The high-temperature Fe_3Al_5 ϵ-phase which exists above 1103°C was found to be orthorhombic.

539.219.2 : 539.42

8898. MICROSCOPIC INVESTIGATION OF CRACK PROPAGATION ON RUPTURE. S.N.Zhurkov and É.E.Tomashevskiĭ.
Zh. tekh. Fiz., Vol. 27, No. 6, 1248-56 (June, 1957). In Russian.
English translation in : Soviet Physics — Technical Physics (New York), Vol. 2, No. 6, 1140-8 (June, 1957).

A micro-cinephotographic method for investigating the propagation kinetics of single through cracks in thin specimens is described. The work was done on cellulose acetate films, apart from a few experiments on polycrystalline foils of zinc and aluminium, and silicate glass plates. It was found that under conditions of uniaxial tension and constant load the rate of propagation of microcracks increases and occupies the major part of the time up to rupture. The propagation velocity increases regularly with stress and depends exponentially upon the stress in the unruptured part of the specimen. An equation is proposed for the velocity of crack propagation and values calculated from it agree well with those determined by experiment. A.E.Kay

539.219.2 : 539.42

8899. ON THE NATURE OF INITIAL RUPTURE. N.D.Sobolev.
Zh. tekh. Fiz., Vol. 27, No. 10, 2273-9 (Oct., 1957). In Russian.
English translation in : Soviet Physics — Technical Physics (New York), Vol. 2, No. 10, 2112-18 (Oct., 1957).

A strip of organic glass with a circular hole was stretched until microscopic cracks appeared around the opening. The region of the cracks is compared with the pattern of lines of equal maximum tensile stress and of equal maximum shear stress, calculated from the full three-dimensional state of stress at each point. Cracks appear to be associated more directly with high maximum tensile stress and occur as tensile fractures, rather than shear fractures. But other evidence shows that incipient shear fracture associated with high tangential stress cannot be ruled out; and the change of state of stress at the instant when an initial crack appears suggests that a final conclusion cannot be drawn on the basis of the original elastic stress distribution alone. J.G.Oldroyd

539.23 : 538.566.2 : 535.399

8900. OVERALL VIEW OF DIFFERENT CONDITIONS LEADING TO ABNORMALLY HIGH ABSORPTIONS OF INCIDENT VIBRATORY ENERGY. M.Gourceaux.
C.R. Acad. Sci. (Paris), Vol. 247, No. 22, 1980-2 (Dec. 1, 1958).
In French.

Compares the abnormally high absorption of electromagnetic waves by thin metallic films, particularly those of granular structure, with that of ultrasonic waves by water, which has a "granular" structure of groups of molecules causing the anomalous absorption at low frequencies and temperatures. J.Hawgood

539.23 : 538.566.2 : 535.399

8901. ABSORBING THIN LAYERS: THE PROBLEM OF OPTIMUM THICKNESS, IN CONNECTION WITH A CLASSIFICATION OF THESE LAYERS. M.Gourceaux.
C.R. Acad. Sci.(Paris), Vol. 248, No. 3, 392-4 (Jan. 19, 1959).
In French.

The thickness corresponding to maximum absorption of the incident energy is calculated for the three types of layer which the author introduced in his classification (see preceding abstract). L.Pincherle

539.23 : 538.566.2 : 535.39

8902. DISCUSSION OF THE EFFECT OF FREQUENCY IN THE PROBLEM OF FINDING THE OPTIMUM THICKNESS OF ABSORPTION FOR A THIN METALLIC LAYER. M.Gourceaux.
C.R. Acad. Sci. (Paris), Vol. 248, No. 17, 2461-2 (April 27, 1959).
In French.

In an earlier paper (see preceding abstract) the optimum thickness was calculated at low frequencies. Here the calculation is extended to all frequencies. B.T.M.Willi

539.23 : 537.53

8903. INFLUENCE OF THE SCATTERING ANGLE ON THE ENERGY SPECTRUM OF A BEAM OF ELECTRONS TRANSMITTE BY A THIN FILM. C.Fert and F.Pradal.
C.R.Acad. Sci. (Paris), Vol. 248, No. 5, 666-9 (Feb. 2, 1959).
In French.

Films of Al, Ge and Mn were studied with a magnetic spectrograph photographing the spectrum for different scattering angles θ u to 15°. Results were in broad agreement with the characteristic energy losses ΔE being due to plasma oscillations: that is, ΔE varied with θ according to a law $\Delta E = a + b\theta^2 + c\theta^4$. L.Pincherl

539.23 : 537.311.33

8904. INVESTIGATION OF THIN, VACUUM DEPOSITED FILMS OF INDIUM ANTIMONIDE. G.A.Kurov and Z.G.Pinsker.
Zh. tekh. Fiz., Vol. 28, No. 10, 2130-4 (1958). In Russian.

From a few mg of InSb prepared by direct fusion of In and Sb, a series of thin (not less than 1 μ thick) films were deposited in a vacuum of approx. 10^{-5} mm Hg on glass or NaCl supports maintaine at about 120°C. Owing to partial decomposition of InSb, there was a gradual change of the properties of the films in any given series. As the distillation process progressed, the blue colour of the first 5-7 specimens changed to brown; then to red, and finally to grey. There was a corresponding change of the electrical conductivity whi decreased gradually to reach a minimum in the red specimens, and then increased again. The thermo-e.m.f. α = 30 μV/°C for the first deposited film decreased gradually, and changed its sign in the 10-t specimen, reaching −240 μV/°C in the 11-th specimen. Then it changed its sign again, α of the 12-th specimen being +420 μV/°C as compared with +380 μV/°C of the starting material. Electron diffraction measurements showed that the first deposited films consisted of pure Sb, the composition of the subsequent specimens changing gradually to InSb, and later to InSb - In. Films characterized by either p- or n-type conductivity were obtained. The carrier mobility increased with increasing size of the crystals of the InSb aggregate. M.H.Sloboda

539.232 : 621.319.45 : 621.357.1

8905. THE IMPEDANCE, RECTIFICATION, AND ELECTROLUMINESCENCE OF ANODIC OXIDE FILMS ON ALUMINUM.
A.W.Smith.
Canad. J. Phys., Vol. 37, No. 5, 591-606 (May, 1959).

An experimental investigation was made of the impedance, rectification, and electroluminescence of anodic oxide films formed on aluminium, in an electrolyte of boric acid and ammonium hydroxide. These properties were studied, where appropriate, as a functi of the surface condition before anodization, the formation voltage, the conductivity of the electrolyte, and the frequency. A constant-voltage formation technique was used. The interpretation of the results suggests that the oxide itself is a good dielectric, but that the film contains defects whose number and form depend on the conditions of formation. The defects appear to control the rectification and electroluminescence and have an appreciable influence on the impedance. The frequency dependence of the capacitance was much smaller than that found by previous workers although there was an appreciable contribution arising from geometrical effects in the electrolytic cell. The zero-thickness potential for the film was found to be in agreement with a theoretical estimate.

539.23

8906. ON THE TWIN STRUCTURE OF NICKEL FILMS ELECTRODEPOSITED ON SINGLE CRYSTALS OF COPPER.
S.Ogawa, J.Mizuno, D.Watanabe and F.E.Fujita.
J. Phys. Soc. Japan, Vol. 12, No. 9, 999-1006 (Sept., 1957).

Single-crystal-like nickel films electrodeposited on copper single crystals were examined by electron diffraction and electro microscopy after films were detached from the substrates. The twin structure in the films which has so far been observed only through diffraction patterns revealed themselves in electron micrographs. In films deposited on electropolished surfaces well marke

111} twin lamellae were observed and their directions satisfied the rystallographical relation. They were scatteringly located and heir width ranged from less than 100 A to several thousand A. They rew up sometimes to be more than 10 μ in length. In films deposited n etched surfaces, on the other hand, such a coarse twin structure as hardly found and the finer took place. The finer twins were in eneral 100 A or less in width and were finely spaced at intervals omewhat larger than the width. The above results were obtained in lms deposited on (110) and (001) faces of copper. Films deposited n surfaces with higher indices, (310) and (531), also showed high pitaxy and marked twin structures.

539.232

907. ON THE MECHANISM OF OXIDE FILM FORMATION ON IRCONIUM. O.Flint and J.H.O.Varley.
. Phys. Chem. Solids, Vol. 6, No. 2-3, 213-22 (Aug., 1958).

Some experiments are described that indicate the extent to hich the initial surface condition of zirconium controls both thermal nd anodic oxidation of the metal. Some observations of the effect f ultraviolet light are also reported. The interpretation suggested or these observations is in terms of the possible variation in lectronic work function and defect state of the oxide depending pon the physical condition of the metal surface. These variations ill effect the efficiency of anodic film formation, and a qualitative cheme of possible mechanisms whereby film growth is controlled described.

539.232

908. A MECHANISM FOR THE FORMATION OF POROUS NODIC OXIDE FILMS ON ALUMINIUM. T.P.Hoar and N.F.Mott.
. Phys. Chem. Solids, Vol. 9, No. 2, 97-9 (Feb., 1959).

It is shown that, in order to account for the formation of orous anodic oxide films on aluminium, it is necessary to assume at oxygen as well as aluminium is capable of diffusing through the ompact part of the film. A detailed discussion of the mechanism given.

539.234

909. STRESS ANISOTROPY IN EVAPORATED IRON FILMS. D.Finegan and R.W.Hoffman.
appl. Phys., Vol. 30, No. 4, 597-8 (April, 1959).

The bending of microscope cover glasses used as substrate was easured optically with Newton's rings. For evaporation at normal cidence the rings were circular, indicating an isotropic stress distribution; whereas evaporation at 22.5° to the substrate normal produced elliptical rings, whose eccentricity indicated that the ratio of e stress in two perpendicular directions in the substrate was 83 ± 0.03. B.T.M.Willis

539.234

910. STRUCTURE OF MAGNESIUM FLUORIDE FILMS ON MORPHOUS SUBSTRATES. N.Morita.
. Phys. Soc. Japan, Vol. 12, No. 10, 1142-8 (Oct., 1957).

Films of thickness from 40 to 8000 A evaporated on optical glass nd on fused quartz were studied by means of electron microscopy nd diffraction. The correlation of structure with optical properties nd tenacity of the films was examined. Films deposited at room emperature were amorphous; the grains remained very small but end to grow in height. Effects of residual gas, contamination of substrate surface and rate of deposition were examined. Films deposited low vacuum were shown to be porous in structure. Films deposited n substrates kept above 220°C had [301] preferred orientation; the rains remained thin and grew along the substrate surface. The uses of tenacity of the films deposited at high substrate temperatures are discussed.

539.234 : 535.393

OPTICAL TRANSMISSION OF EVAPORATED In, Sn, AND Bi ILMS IN THE VACUUM ULTRAVIOLET. See Abstr. 7986

539.26 : 621.791.3

911. AN X-RAY INVESTIGATION OF ALLOY PHASES IN OLDERED JOINTS. F.H.Scott.
ahiers de Phys., Vol. 11, 369-82 (Oct.-Nov., 1957).

The use of soldered joints as a method for producing high onstraints in ductile metals is found to be limited by alloying and iffusion between the solder and soldered metal. Fracture is found take place in the intermediate phases of the equilibrium system hich form in thin layers at the interface between solder and oldered metal. In cases where copper is soldered with zinc or cadmium, fracture takes place at the junction between the cubic and ϵ phases which is the weak plane of fitting. In the case of zinc soldered with copper it was found that there is preferred orientation of the crystals in the surface of fracture, the 111 γ and $11\bar{2}0$ ϵ lying in the plane of fracture. It is shown that this is consistent with fitting between the 111 plane of the γ phase and the $10\bar{1}4$ ϵ plane which is the known plane of segregation of η zinc in the ϵ phase. If the direction of this latter plane, with respect to the surface of fracture, is considered constant, anomalous X-ray diffraction streaks are explained as a consequence of variation of composition between the boundaries of the ϵ phase. It is suggested that such coring of solid solutions must be considered as a possible cause of line broadening in powder photographs where non-equilibrium conditions can be expected.

539.26

8912. X-RAY MEASUREMENT OF MICROSTRAINS IN GERMANIUM SINGLE CRYSTALS. L.P.Hunter.
J. appl. Phys., Vol. 30, No. 6, 874-84 (June, 1959).

The high intensity of the anomalously transmitted X-ray beam depends upon the coincidence of the nodal planes of the X-ray wave field with one set of atomic planes within the crystal when the crystal is set for Laue diffraction. If there is any structural defect within the crystal which causes some of the atoms of the crystal to deviate from their normal location in perfect planes, these atoms will no longer be at the nodes of the X-ray wave field and by their absorption they will reduce the transmitted intensity. It is shown how this effect may be employed to measure the amount of microstrain present in nearly perfect germanium crystals. It is found that some apparently dislocation-free crystals show a greater degree of crystalline imperfection than crystals with a finite dislocation count.

539.26

8913. INFLUENCE OF EXTINCTION ON THE INTENSITY OF X-RAY INTERFERENCES IN THE INVESTIGATION OF STEEL. E.L.Gal'perin and Yu.S.Terminasov.
Zh. tekh. Fiz., Vol. 27, No. 6, 1379-85 (June, 1957). In Russian.
English translation in : Soviet Physics — Technical Physics (New York), Vol. 2, No. 6, 1276-81 (June, 1957).

Heat-treated specimens of two steels were studied. Molybdenum K α radiation was used and the intensities were recorded photographically and measured photometrically. Control measurements showed that fluctuations in the intensity of the primary beam did not exceed ± 2% during the experiments. The absolute intensities of (110) and (220) interferences were measured for disks of one of the steels using iron K α radiation and an ionization X-ray equipment. It is concluded that for molybdenum radiation the influence of extinction may be ignored when the maximum dimensions of the coherent blocks in the specimen do not exceed 1 to 2×10^{-4} cm and when reflections corresponding to angles $> 15^{\circ}$ are being examined. With soft radiations (Co,Fe,Cr) under these conditions, extinction might be appreciable. A.E.Kay

539.27

8914. NON-DESTRUCTIVE TECHNIQUE FOR THE STUDY OF FRACTURE SURFACES IN THE ELECTRON MICROSCOPE. E.Mencarelli and P.A.Jacquet.
C.R. Acad. Sci. (Paris), Vol. 248, No. 17, 2477-9 (April 27, 1959). In French.

A two-stage collodion-carbon technique is described for making extraction replicas of fracture surfaces. The method has been applied to steels and "Nimonic" alloys.

A.E.I.Research Laboratory

539.27

8915. CONTRIBUTIONS TO QUANTITATIVE ELECTRON MICROSCOPY. E.Zeitler and G.F.Bahr.
J. appl. Phys., Vol. 30, No. 6, 940-4 (June, 1959).

The effect of various parameters on contrast in an electron microscope image is analysed and a simplified formula tested. The dependence of contrast on the weight per unit area, voltage, and aperture is in good agreement with the theory of electron scattering. The observed dependence of screening angle on atomic number deviates from the theory for higher atomic numbers, but carbon and elements of comparable atomic number are not affected. The application of quantitative electron microscopy to biological objects can be considered workable to ±10%.

539.27 : 539.2 : 538.2

ELECTRON MIRROR MICROSCOPY OF MAGNETIC STRAY FIELDS ON GRAIN BOUNDARIES. See Abstr. 8301

539.27 : 537.533

NEW ELECTRON DIFFRACTION APPARATUS FOR CONTINUOUS RECORDING. See Abstr. 8227

539.27

8916. ELECTRON-DIFFRACTION STUDY OF THE OXIDATION OF ALUMINIUM ALLOYS. Yu.D.Chistiakov and M.V.Mal'tsev.
Kristallografiya, Vol. 2, No. 5, 628-33 (1957). In Russian.
English summary in: Soviet Physics — Crystallography (New York), Vol. 2, No. 5, 620-5 (Sept.-Oct., 1957).

It was found, using electron diffraction and electron microscopy, that various "active" metals have a considerable influence on the structure and properties of the surface films formed on Al and its alloys. The metals investigated were Be, Li, Ca, Sr, Ba and Mg. The nature and formation of the surface film was related to the presence of the "active" constituent in each case. J.Thewlis

539.27

8917. MEASUREMENT OF THE INTENSITIES OF ELASTICALLY AND INELASTICALLY SCATTERED ELECTRONS WITH A RETARDING-FIELD ARRANGEMENT.
M.Horstmann, G.Meyer and H.Raether.
Z. Phys., Vol. 154, No. 5, 633-8 (1959). In German.

A retarding field apparatus for the measurement of angular and energy distributions of scattered electrons (15 to 50 keV) is described. The apparatus was used for investigations into the influence of crystal size and electron energy on the elastically scattered intensity in Debye—Scherrer diagrams of aluminium. The results are discussed with respect to the dynamical and kinematical theory. It proves, that the kinematical theory does not hold for crystallites of 100 A thickness or more.

539.27

8918. SUBMICROSCOPIC TOPOGRAPHY OF OXIDIZED SURFACE OF STIBNITE AND ETCHED SURFACE OF ZINCBLENDE.
M.Watanabe.
J. Phys. Soc. Japan, Vol. 12, No. 8, 874-82 (Aug., 1957).

Submicroscopic topographies of oxidized stibnite and of etched zincblende were examined by electron microscopy. Crystallites of antimony oxide formed on stibnite have a roof-like shape bounded by two well-developed and four less-developed {111} faces. This is in agreement with the conclusion drawn previously from electron diffraction study. Direct observation by electron microscope gives further information on the growth of the oxide. Zincblende surfaces etched by hydrochloric acid have a shape which is slightly different from the negative triakis tetrahedron inferred from an electron diffraction study. In the diffraction patterns from this surface, structures of reflection spots finer than those previously reported were observed and analysed by the theory of the dynamical refraction effect.

ELASTICITY . STRENGTH . RHEOLOGY

539.3

8919. THEORETICAL VALUE OF THE DYNAMIC STRETCH MODULUS OF CELLULOSE. W.J.Lyons.
J. appl. Phys., Vol. 30, No. 5, 796-7 (May, 1959).

Using a development of the method of Meyer and Lotmar [Helvetica Chimica Acta, Vol. 19, 68-86 (1936)], the dynamic stretch modulus of a perfect crystallite of cellulose was calculated as 18.0×10^{11} dyne cm^{-2}. The middle of a range of recorded experimental values is an order of magnitude less than this theoretical value, an expected result due to the effect of distributed amorphous material on the mechanical properties of a polymer.
B.J.Wilson

539.313

8920. SOME BASIC PRINCIPLES IN THE MECHANICS OF SOLIDS WITHOUT A NATURAL TIME. R.Hill.
J. Mech. Phys. Solids, Vol. 7, No. 3, 209-25 (June, 1959).

The solids considered are defined by tensor relations of type stress-rate component = f(strain-rate components), where the functions f, homogeneous of degree one in the components of strain-rate, can be non-linear and depend also on the current stress and entire strain-history. The solids are classified by their behaviour in vanishingly small closed cycles of strain. Questions of uniqueness and stability are examined in full generality. The results are sharpened when the functions f are the derivatives of a potential function of the strain-rate components. Extremum theorems and a generalized Rayleigh principle are proved. Various defintions of stress-rate are discussed, particularly the convected derivative of the Kirchhoff—Trefftz stress. This is used to construct constitu tive equations for a very general class of solids including metals. The concept of a yield surface is critically analysed and generalize

539.31

8921. A METHOD FOR SOLVING LINEAR THERMOELASTIC PROBLEMS. R.J.Knops.
J. Mech. Phys. Solids, Vol. 7, No. 3, 182-92 (June, 1959).

The equations of thermoelasticity are shown to be identical in form to those obtained by subtracting the isothermal elastic equations for two arbitrary Poisson's ratios. The identity is used to formulate a relation between the two branches of elasticity which is applied to the solutions of thermoelastic problems. The procedure is illustrated by the problems of the half-space and the space bounded by two infinite planes and gives shorter solutions than hitherto.

539.319 : 535.55

AN OPTICAL METHOD FOR INVESTIGATING THE AVERAGE STRAINED STATES OF FINE GRAINED POLYCRYSTALS. See Abstr. 8009-12

539.3

8922. THE TENSILE PROPERTIES OF HIGH-PURITY NIOBIUM AT LOW TEMPERATURES.
B.F.Dyson, R.B.Jones and W.J.McG. Tegart.
J. Inst. Metals, Vol. 87, Pt 10, 340-2 (June, 1959).

Tested over the range −196° to 240°C. Yield points were observed at all temperatures, the magnitude of the yield drop increasing with decreasing temperature. The temperature-dependen of the yield stress was similar to that of other body-centred cubic metals, and the material was ductile at −196°C. Some experiments on strain-ageing are reported. The results suggest that oxygen is responsible for the observed repeated yielding and return of yield point on ageing.

539.32 : 536.41

8923. ON SOME PHYSICAL PROPERTIES OF CEMENTITE.
F.Laszlo and H.Nolle.
J. Mech. Phys. Solids, Vol. 7, No. 3, 193-208 (June, 1959).

Young's modulus and the shear modulus of elasticity of low carbon steel as supplied, and after case carburization to hypereutectoid carbon content, were determined from the natural frequencies of free-free resonant longitudinal and torsional vibrations of tubular test specimens. The coefficients of thermal expansion of this steel in these states were also established. Since it was discovered that the tube used was not sufficiently quasi-isotropic, only two carbon concentrations were examined, and the individual elastic constants and coefficients of thermal expansion of random aggregates of crystals of low alloy ferrite of a certain chemical composition on the one hand, and of random aggregates of cementite crystals on the other hand, were determined from only two sets of measurements. However, different methods of checking the results suggest that their accuracy may be neverthele fair. The thermal stresses which develop in normalized steels of carbon contents used for these experiments were computed.

539.3

8924. THE ELASTIC CONSTANTS OF ZINC BETWEEN 4.2° AND 670°K. G.A.Alers and J.R.Neighbours.
J. Phys. Chem. Solids, Vol. 7, No. 1, 58-64 (Oct., 1958).

The five adiabatic elastic constants of Zn single crystals wer measured using an ultrasonic-pulse technique. Although the temperature variation is not exactly linear, no very rapid changes occu even as the melting point is approached. The room-temperature values agree well with other data. The 4.2°K values are: $C_{11} = 17.909$, $C_{33} = 6.880$, $C_{44} = 4.595$, $\frac{1}{2}(C_{11}-C_{12}) = 7.080$, $C_{12} = 3.7$ and $C_{13} = 5.54$ in units of 10^{11} $dynes/cm^2$.

539

8925. SINGLE-CRYSTAL ELASTIC CONSTANTS OF LITHIUM
H.C.Nash and C.S.Smith.
J. Phys. Chem. Solids, Vol. 9, No. 2, 113-18 (Feb., 1959).

The elastic constants of single-crystal lithium have been measured by the ultrasonic pulse-echo technique. The results, in its of 10^{11} dyn cm^{-2}, are:

Temperature (°K)	C_{44}	$(C_{11}-C_{12})/2$	B_S
78	1.08	0.116	1.33
155	1.00	0.111	1.25
195	0.96	0.109	1.20

ere B_S is the adiabatic bulk modulus. These results are comred with Fuchs's theoretical calculation of the Coulomb contribuon to the shear stiffness of the alkali metals, which in lithium is e only significant contribution. Extrapolation of the experimental lues to absolute zero gives values for both C_{44} and $(C_{11}-C_{12})/2$ ich are lower than the corresponding theoretical values. The trapolated anisotropy, $C_{44}/(C_{11}-C_{12})/2$, is higher than the value edicted by the theory.

539.32

26. THE TEMPERATURE-DEPENDENCE OF THE ELASTIC ODULI OF VITREOUS SILICA. G.J.Dienes.

Phys. Chem. Solids, Vol. 7, No. 4, 290-4 (Dec., 1958).

The temperature-dependence of the elastic moduli of vitreous lica is anomalous in the sense that the moduli of this substance crease with increasing temperature above 60° K. This anomalous haviour is investigated theoretically, and it is shown to be ready implied by the very low coefficient of thermal expansion. is convenient to express the overall temperature coefficient of the odulus as the sum of two terms: the pure volume term (temperare constant) and the pure temperature term (volume constant). e low coefficient of expansion plays a double role in leading to overall positive temperature coefficient for the moduli: it duces the pure volume term essentially to zero and it changes e pure temperature term from a negative to a positive one. No nclusions can be drawn about the structure of vitreous silica om the anomalous behaviour of its moduli, since this behaviour essentially a reflection of the anomalously low coefficient of ermal expansion. The important unsolved problem is the eoretical elucidation of the thermal expansion of this substance.

539.32 : 534.22

TEMPERATURE DEPENDENCE OF ELASTIC CONSTANTS A SILICON SINGLE CRYSTAL. See Abstr. 7882

539.32

27. PRESSURE DERIVATIVES OF THE ELASTIC CONSTANTS ALUMINUM AND MAGNESIUM. R.E.Schmunk and C.S.Smith.

Phys. Chem. Solids, Vol. 9, No. 2, 100-12 (Feb., 1959).

The pressure derivatives of the elastic stiffness constants of uminum and magnesium have been measured over a pressure nge from 0 to 6500 bars, by a modified ultrasonic pulse-echo ethod. The values found are:

	dC/dP	dC'/dP	dB_S/dP
	2.31	1.62	5.19

	dC_{11}/dP	dC_{33}/dP	dC/dP	dC'/dP	dC_H/dP
g	6.11	7.22	1.58	1.36	13.7

e notation $C = C_{44}$, $C' = (C_{11}-C_{12})/2$, $B_S = (C_{11} + 2C_{12})/3$, and $= C_{11} + C_{12} + 2C_{33} - 4C_{13}$ has been used. The pressure data for uminum have been interpreted in terms of Leigh's theory bstr. 3088 of 1951) for the elastic stiffness themselves, and the agnesium data in terms of the similar theory of Reitz and Smith bstr. 2460 of 1957). Variation of the effective charge density at e boundary of the atomic polyhedron under volume strain causes e electrostatic contribution to the shear stiffnesses to vary proximately as r^{-8} instead of r^{-4} for both metals. Electron ansfer from states overlapping one type of Brillouin-zone face to ates overlapping another type of face under volume strain conbutes appreciably to the variation of the Fermi shear-stiffness ntribution with pressure.

539.32

28. CORRECTION TO THE THEORY OF THE CALCIUM LUORIDE LATTICE. A.K.Rajagopal.

oc. Phys. Soc., Vol. 73, Pt 4, 687-9 (April, 1959).

Calculations on CaF_2 in Abstr. 1904 (1959) used expressions due Born (1923) which have been found to be incorrect. The correct pressions are given, and the requisite corrections to the calculans on CaF_2 are made; they do not invalidate the qualitative concluons. J.Hawgood

539.373

8929. SLIP SOURCES ON SODIUM CHLORIDE SURFACES.

Z.Morlin.

Nature (London), Vol. 183, 1319-20 (May 9, 1959).

Slip sources on the surfaces of NaCl crystals were revealed by etching in NaCl solution, followed by epitaxial growth from the same solution, of which the degree of supersaturation was controlled by variations of temperature. Etching in 80% alcohol, and quenching from 600° C, were also employed. J.Thewlis

539.374

8930. ON "LINEAR" PLASTICITY. M.Matschinski.

C.R. Acad. Sci. (Paris), Vol. 248, No. 5, 636-9 (Feb. 2, 1959).
In French.

A linear theory of plasticity can be built up for a thin layer of material by supposing a linear relation between thickness, rate of change of thickness and the Laplacian ∇^2 of these two qualities. A more general theory would treat matter in bulk as a number of thin "linear" layers separated by slip lines. Applications are being made to the theory of plastic flow of glaciers and of the Earth's crust. J.G.Oldroyd

539.374

8931. INVESTIGATION OF DEFORMATION PROCESSES IN ARMCO IRON BY MEANS OF INTERNAL FRICTION AT MEGACYCLE FREQUENCIES. W.J.Bratina.

Canad. J. Phys., Vol. 37, No. 5, 579-90 (May, 1959).

Internal friction, employing frequencies in the megacycle range, has been used in order to study the characteristics of elastic and plastic deformation in Armco iron. Tensile stresses only were applied. Among the characteristic features observed three were investigated in detail. (1) A decrease in ultrasonic attenuation at external static stresses within the elastic range, which appears to be related to the ordering effect of the stress on magnetic domains, was investigated. (2) An initial increase in attenuation values regularly observed, in cold-worked specimens upon the application of an external load was shown to be associated with the internal stresses. (3) The changes in attenuation resulting from plastic deformation were found to be insignificant in some instances and large in others. An explanation employing the magnetic domain theory and dislocation mechanisms is suggested.

539.374

8932. THEORY OF VISCOELASTICITY OF AMORPHOUS POLYMERS. II. A NOTE ON THE TIME—TEMPERATURE REDUCIBILITY OF THE RELAXATION AND RETARDATION SPECTRA. O.Nakada.

J. Phys. Soc. Japan, Vol. 12, No. 11, 1218-25 (Nov., 1957).

For Pt I, see Abstr. 10013 (1955). Equivalence of temperature change and shift of log-time scale is usually assumed empirically in obtaining a master curve of relaxation and retardation spectra in polymers. In this paper the molecular theoretical basis of this assumption — which is referred to as time—temperature reducibility — is elucidated by an examination of the generalized diffusion equation in the configuration space of a polymer chain. Several criteria for the reducibility are deduced.

539.374 : 548.5

8933. STRENGTH OF GOLD WHISKERS. S.S.Brenner.

J. appl. Phys., Vol. 30, No. 2, 266-7 (Feb., 1959).

The elastic characteristics of Au whiskers indicate that oxide films do not greatly contribute to their strength or mode of plastic deformation. R.F.Peart

539.382 : 536.72

8934. THERMOELASTIC PHENOMENA IN SKS-30A AND SKB RUBBERS IN ADIABATIC DEFORMATION UP TO THE BREAKING POINT. M.P.Votinov and E.V.Kuvshinskii.

Zh. tekh. Fiz., Vol. 27, No. 10, 2303-6 (Oct., 1957). In Russian.
English translation in: Soviet Physics — Technical Physics (New York), Vol. 2, No. 10, 2139-42 (Oct., 1957).

The observed relationships between extension ratio (up to 6-7 at rupture), tensile stress, mechanical work done, and temperature rise are given for filled and unfilled rubbers with varying vulcanization times. There is no evidence of crystallization and the elastic forces are evidently related simply to the thermal motion of the macromolecules almost up to the point of rupture, Only in the rubbers of greatest rigidity containing active fillers (lamp black and silica gel) does the heating fall off at very large extensions due to hardening (disturbed thermal motion of the macromolecules at high orientation). J.G.Oldroyd

539.383

8935. DISTRIBUTION OF INTERFACE STRESS IN PLANE STRAIN AND AXIAL SYMMETRIC COMPRESSION.

G.T.van Rooyen and W.A.Backofen.

J. Mech. Phys. Solids, Vol. 7, No. 3, 163-8 (June, 1959).

Measurements have been made of the stress distribution in compressing lead between roughened steel plates with sticking over the interface. The method involved use of pressure sensitive pins embedded in one plate. A general agreement was found between plane strain theory (Hill, et al. 1951) and experiment for the condition examined of $w_0/h_0 = 12$. The plane strain solution was also found to describe the pressure distribution over most of the interface in axial symmetric compression; over a narrow region at the periphery, however, a pressure discontinuity occurred which resembled a plateau and was dependent upon geometry, becoming less apparent with d_0/h_0 increasing from 4 to 12.

539.385

8936. ON THE PHENOMENOLOGY OF DAMPING OF TORSIONAL OSCILLATIONS IN METAL WIRES.

V.N.Rozhanskii and N.V.Dekartova.

Dokl. Akad. Nauk SSSR, Vol. 121, No. 2, 274-6 (1958). In Russian.

The authors suggest that the apparent time-dependence of damping constant and frequency during the decay of free oscillations can be satisfactorily ascribed to a first-order dependence on amplitude alone. They used zinc and copper wires, distinguishing between mono- and polycrystalline specimens, but no mention of work- or heat-treatment is given. The amplitude-dependence, and also the difference between static and oscillatory viscosities, is attributed to the surmounting of obstacles by dislocations, but no numerical interpretation is attempted. I.D.C.Gurney

539.385

8937. STABLE AND UNSTABLE MACROLOCALIZATION OF PLASTIC DEFORMATION [OF STEEL] IN STATIC TORSION.

F.P.Rȳbalko and M.V.Yakutovich.

Fiz. Metallov i Metallovedenie, Vol. 4, No. 3, 450-4 (1957). In Russian.

539.385

8938. STUDY OF NONUNIFORMITY OF PLASTIC DEFORMATION [OF STEEL] IN TORSION BY THE METHOD OF MILLED-ON GRIDS.

T.K.Zilova, N.I.Demina and Ya.B.Fridman.

Fiz. Metallov i Metallovedenie, Vol. 4, No. 3, 455-69 (1957). In Russian.

539.4.013

8939. ON THE STATISTICAL THEORY OF THE SCALE FACTOR.

M.I.Éstrin.

Zh. tekh. Fiz., Vol. 28, No. 10, 2260-1 (1958). In Russian.

The dependence of strength on the dimensions of a body is considered. A variant of the statistical theory is proposed, using stationary random functions. The case of a thin rod is discussed, by means of a fictitious external body force which replaces the forces due to imperfections. (It is a random function of position but proportional to the applied stress). Taking the special case of a body-force whose auto-correlation is a delta-function, the author obtains an expression for breaking stress as a function of length. This is fitted to the experimental values of Shevandin and Manevich [Zh. tekh. Fiz.,Vol. 16, 1223 (1946)] to obtain reasonable agreement, although these data are not strictly comparable with the case considered. I.D.C.Gurney

539.4.015

8940. WHISKER STRUCTURE AND TENSILE STRENGTH.

H.Weik.

J. appl. Phys., Vol. 30, No. 5, 791-2 (May, 1959).

The investigation was made to determine whether or not the extreme high tensile strength of metal whiskers is due to their perfect growth. The samples were grown from ferrous chloride by reduction in H_2 and A at 650°C and showed a special surface behaviour after failure. The skin appeared to be about 1200 atoms thick, but was found to be of the same material as the core and not oxide or corrosion film. The core was found to be layered and the distances between layers were similar to those at the surface. Iron whiskers were then nickel plated with a layer 100 atoms thick and a marked increase of tensile strength occurred. When plotted against the reciprocal of the cross-section area, the tensile strength of the nickel plated whiskers fell on a straight line, while the uncoated whiskers have an upward bending curve. The layered whiskers also exhibited linear behaviour when plotted in this way. It is suggested that the whiskers grew in a shell or layer manner, perpendicular to the axis and the boundary areas between individual growth lamellae exhibit extended lattice disturbance parallel to the axis. Such a sub-structure might hinder the movement of dislocations perpendicular to the tensile direction and give a high tensile strength. A.C.Whiffin

539.42 : 539.219.2

MICROSCOPIC INVESTIGATION OF CRACK PROPAGATION ON RUPTURE. See Abstr. 8898

539.42 : 539.219.2

ON THE NATURE OF INITIAL RUPTURE. See Abstr. 8899

539.434

8941. MODIFICATIONS OF THE LOMNITZ-JEFFREYS LAW OF CREEP.

J.R.Macdonald.

J. appl. Phys., Vol. 30, No. 3, 453-4 (March, 1959).

Creep functions are proposed which correspond to a finite strain under all conditions and to a distribution function of relaxation times which can be normalized. J.G.Oldroyd

539.434

8942. CREEP IN ZINC SINGLE CRYSTALS AT THE TEMPERATURE OF LIQUID NITROGEN.

H.P.Stüwe.

J. appl. Phys., Vol. 30, No. 3, 450-1 (March, 1959).

Previous work of the author (Abstr. 9155 of 1958) on the creep properties of zinc single crystals is extended by repeating the creep tests at temperature of liquid nitrogen. The existence of a temperature independent critical shear stress was again observed, suggesting that the Cottrell—Jaswon atmospheres already exist in the undeformed lattice around grown-in dislocations, there being insufficient time (at liquid nitrogen temperatures) for such atmospheres to form during the loading time. R.Bullough

539.576

8943. RELATION BETWEEN WEAR AND FRICTION.

J.J.Bikerman.

J. appl. Phys., Vol. 30, No. 3, 448-9 (March, 1959).

Critical comments concerning the interpretation of experiments in which a radioactive copper hemisphere was rubbed against a steel plate. They are based on estimates of the proportion of either the force or the energy of friction which is consumed for abrasion. This proportion is very small indeed within the region of small values of the normal load. R.Schnurmann

539.6

8944. ADHESIVE PROPERTIES OF ICE.

H.H.G.Jellinek.

J. Colloid Sci., Vol. 14, No. 3, 268-79 (June, 1959).

An apparatus has been constructed for the investigation of the adhesive strength of ice by shear experiments. For the system snow-ice/stainless steel, shear experiments yielded pure adhesive breaks down to a temperature of about −13°C, where a sharp transition to cohesive breaks took place. The adhesive strength for this system is a linear function of the temperature, and is independent of the cross-sectional area and height of specimens in the ranges investigated. The system ice/polystyrene gave pure adhesive breaks on shear. The adhesive strength was found to be a linear function of temperature down to a temperature of −15°C and independent of cross-sectional area. Tensile experiments on the system ice polystyrene yielded a linear relationship between adhesive strength and temperature in a range from −2 to −25°C. Cross-sectional area and rate of stress application had no effect on the adhesive strength in the ranges investigated. The system ice/polymethylmethacrylate showed a larger adhesive strength than the system ice/polystyrene. The experimental results are explained by the assumption of a liquid-like layer between ice and the solid interface. The thickness and consistency of this liquid-like layer are a function of temperature and the nature of the solid interface. The surface tension forces and frictional forces operative in the liquid-like layer are discussed.

539.61

8945. THE ADHESION OF MICROCRYSTALLINE PHOSPHORS ON GLASS SURFACES.

I.Hangos.

Exper. Tech. der Phys., Vol. 6, No. 5, 228-38 (1958). In German.

An experimental determination of the conditions for adhesion of light sensitive phosphor films on glass surfaces. T.C.Toye

539.62

946. A PROPOSED MECHANISM FOR ICE FRICTION. .D.Niven.
anad. J. Phys., Vol. 37, No. 3, 247-55 (March, 1959).

The collapsible structure of ice is stressed. The adhesion bond s visualized as being associated with a readjustment of a partially ollapsed or distorted molecular structure when cooling sets in fter plastic flow has occurred in the asperity. With this general lea in view the friction mechanism on ice is compared in detail ith that on a non-collapsible material, and explanations for obserations are suggested.

539.621

8947. FRICTIONAL MEASUREMENTS ON FIBROUS MATERIALS. W.F.du Bois.
Textile res. J., Vol. 29, No. 6, 451-66 (June, 1959).

A method for measuring the coefficient of static friction is described. Results obtained on various materials are given. A statistical analysis of the relationship between frictional forces and normal load does not confirm the empirical equations given by other workers, but leads to a quadratic formula.

PHYSICAL CHEMISTRY

PHASE EQUILIBRIUM
CHEMICAL REACTIONS

541 : 539.1

RELATION $x + y = 136$ BETWEEN THE NUCLEAR AND HEMICAL STABILITY NUMBERS. See Abstr. 8395

541.12 : 539.12

CHEMICAL REACTIONS OF POSITRONIUM IN AQUEOUS OLUTIONS. See Abstr. 8446

541.123

948. HYDROGEN → DEUTERIUM EXCHANGE REACTION IN IBROUS PROTEINS. II. R.D.B.Fraser and T.P.Macrae.
chem. Phys., Vol. 31, No. 1, 122-6 (July, 1959).

Previously it was shown (Abstr. 892, 5218 of 1958) that when -keratin is reacted with deuterium oxide the peptide hydrogens the crystalline regions are not replaced by deuterium. In the resent contribution it is shown that when the native configuration this protein is destroyed, for example by stretching or superontraction, complete replacement is obtained. Neither cleavage the disulfide linkages nor treatment with acetic acid-d, which educes the crystallinity appreciably, effects complete exchange in -keratin and it is presumed therefore that the array of hydrogen onds in the native monomeric unit is one of high inherent stability. his stability is attributed to its α-helical configuration, cyclic ature and to interactions between side chains along the area of ontact between the helix pair forming the cyclic unit. When ollagen is reacted with deuterium oxide complete exchange is apidly attained and this is correlated with the fact that the hydrated ollagen is not appreciably stabilized by side-chain interactions d that the hydrogen bond array is only partially intrahelical.

541.124 : 535.333

949. RESOLVED INFRARED EMISSION SPECTRUM OF THE EACTION ATOMIC H$^{\cdot}$ PLUS Cl_2. J.K.Cashion and J.C.Polanyi.
. chem. Phys., Vol. 30, No. 4, 1097-8 (April, 1959).

The bands reported in Abstr 8498 (1958) have been studied with igher resolution, confirming that at least 25% of the vibrationally xcited HCl is originally formed in states higher than $\nu = 1$, and at in some cases over 90% of the energy of reaction appears as ibrational energy. Rotation—vibration interaction is discussed; values up to 14, and ν values up to 6, were observed, and the elative populations determined. J.Hawgood

541.124

950. SOME NOTES ON CHARGE TRANSFER INTERACTION ETWEEN IODINE AND POLYNUCLEAR AROMATIC HYDROARBONS. R.Bhattacharya.
chem. Phys., Vol. 30, No. 5, 1367-8 (May, 1959).

Data are adduced to show that the charge transfer energy is ot appreciably affected by change in the dielectric constant of the edium, from which it is concluded that the charge transfer takes ace between molecules held together by forces other than electroatic. W.Good

541.124

8951. H THEOREMS FOR ONE-DIMENSIONAL COMBUSTION OF A GAS. G.Rosen.
J. chem. Phys., Vol. 31, No. 1, 253-7 (July, 1959).

The equations for unsteady one-dimensional combustion processes are derived under very justifiable physical assumptions. The combustion equations dictate that a functional of the temperature distribution, called H, always decreases with time at an increasing absolute rate. This H theorem is used to determine the critical size of a pocket of gas which can instigate combustion waves. For the case of "normal" diffusion, the asymptotic combustion equation implies that a second functional of the temperature distribution, called H^*, always decreases with time at a decreasing absolute rate. This second H theorem is associated with a dynamical principle equivalent to the full content of the asymptotic combustion equation.

541.124 : 533.6.011.4

SUPERSONIC NOZZLE FLOW WITH A REACTING GAS MIXTURE. See Abstr. 7865

541.124 : 538.27

STUDIES OF REACTIONS OF ANILINE MIXTURES WITH GLACIAL ACETIC ACID BY PROTON MAGNETIC RESONANCE. See Abstr. 8364

541.126 : 534.222.2

8952. TRANSITION FROM DEFLAGRATION TO DETONATION IN CAST EXPLOSIVES. A.Maček.
J. chem. Phys., Vol. 31, No. 1, 162-7 (July, 1959).

An experiment is described in which velocity and pressure changes during the transition from slow burning to detonation in cast explosives are measured. A simple one-dimensional physical model of explosive burning under confinement is assumed and used, in connection with experimental evidence, as the basis for a calculation of the time and distance necessary to start a shock in a deflagrating solid explosive. The calculated distance of incipient shock formation is 11-15 cm. This result supports the hypothesis that transition from slow burning to detonation is due to a shock which arises spontaneously in a confined burning medium. The nature of the shock-forming pressure pulse, $p = p(t)$, is discussed.

541.126 : 534.222.2

SHOCK-TUNNEL COMBUSTION OF OXYGEN—HYDROGEN MIXTURES. See Abstr. 7891

541.127

8953. APPARENT ORDER OF HETEROGENEOUS SPRAY REACTIONS. F.A.Williams.
J. chem. Phys., Vol. 30, No. 4, 1017-19 (April, 1959).

It is demonstrated that when measurements are made in a steadily flowing gas in which a spray is suspended, the observed heterogeneous reaction rate order with respect to the material composing the spray is usally determined by the particle size distribution and is largely independent of the single-particle reaction order. An explicit expression for the dependence of the apparent order upon the size distribution is derived.

541.127 : 539.19

8954. CARBON—HYDROGEN—ACETYLENE EQUILIBRIUM AT HIGH TEMPERATURES. M.N.Plooster and T.B.Reed.

J. chem. Phys., Vol. 31, No. 1, 66-72 (July, 1959).

The concentration of acetylene in equilibrium with carbon and hydrogen at temperatures up to 3000°K was measured experimentally using water-cooled quenching probes in a carbon tube furnace. Previous calculations of the thermodynamic properties of acetylene were extended to cover this temperature range. Also, the effects of free radical species present at these temperatures were estimated. The only ones deemed important in the temperature range of this investigation were H and C_2H; an estimate was made of the free energy of C_2H to predict its effect on the composition of the quenched gas samples from the furnace. The predicted quenched gas compositions are in good agreement with the experimental measurements.

541.127

8955. INFLUENCE OF PRESSURE ON THE HAMMETT REACTION CONSTANT.

A.J.Ellis, W.S.Fyfe, R.I.Rutherford, A.Fischer and J.Vaughan.

J. chem. Phys., Vol. 31, No. 1, 176-7 (July, 1959).

The probable effect of pressure on the Hammett reaction constant is predicted for heterolytic and homolytic reactions in polar and nonpolar solvents. There are insufficient data in the literature to test the conclusions reached but some previously unpublished measurements appear to be in line with one prediction.

541.127 : 539.18

IDEALIZED THEORY OF THE RECOMBINATIONS OF ATOMS BY THREE-BODY COLLISION. See Abstr. 8690

541.128 : 577.15

8956. MECHANISMS OF ENZYME ACTION. R.A.Alberty.

Rev. mod. Phys., Vol. 31, No. 1, 177-84 (Jan., 1959).

Enzymes are the catalysts of biological reactions. The methods and ideas of chemical reaction kinetics are applied to biological reactions in an attempt to understand the way in which enzymes function. Forty-seven references. J.Iball

ELECTROCHEMISTRY

541.131

8957. VOLTAMMETRY WITH LINEARLY VARYING POTENTIAL: CASE OF IRREVERSIBLE WAVES AT SPHERICAL ELECTRODES. R.D.DeMars and I.Shain.

J. Amer. Chem. Soc., Vol. 81, No. 11, 2654-9 (June 5, 1959).

The theory of voltammetry with linearly varying potential has been extended to the case of irreversible electrode reactions at spherical electrodes. Theoretical current—voltage curves were constructed from the results of a numerical calculation which assumed a first-order electrode reaction occurring at potentials where the rate of the back reaction is negligible. The curves make it possible to determine the kinetic parameters of the electrode reaction from an experimental irreversible wave. Effect of variation of any of the experimental parameters was also considered. The theory was checked by comparison with current—voltage curves obtained for the reduction of iodate ion.

541.132

8958. DETECTION OF ELECTROLYTICALLY GENERATED TRANSIENT FREE RADICALS BY ELECTRON SPIN RESONANCE. A.H.Maki and D.H.Geske.

J. chem. Phys., Vol. 30, No. 5, 1356-7 (May, 1959).

A derivative spectrum of radicals is obtained by electro-oxidation of 0.1 M $LiClO_4$ in acetonitrile, carried out in an electron spin resonance spectrometer. A possible electrode reaction scheme is discussed. G.I.W.Llewelyn

541.132.3

8959. pH MEASUREMENTS WITH A GLASS ELECTRODE WITHSTANDING 1500 kg/cm² HYDROSTATIC PRESSURE. A.Disteche.

Rev. sci. Instrum., Vol. 30, No. 6, 474-8 (June, 1959).

A glass electrode can be made to withstand high hydrostatic pressure, up to 1500 kg/cm², by separating the inside fluid from the outside one with a layer of silicone oil acting as a liquid piston, enabling the inside and outside pressure to compensate continuously. Such a glass electrode, with two Ag—AgCl electrodes, maintains its hydrogen electrode function at high pressure. pH changes resulting from dissociation constant shifts caused by pressure in acid and buffer solutions have been measured in good agreement with theoretical expected values for HCl, acetic acid, carbonic acid, and acetate buffer. No agreement was found for bicarbonate buffer. Phosphate buffer and sea water have also been tested. An adapted version of the cell-assembly is planned to equip the French bathyscaphe for deep-sea investigations.

541.133

8960. CONDUCTANCE OF DILUTE SOLUTIONS OF 1—1 ELECTROLYTES. R.M.Fuoss.

J. Amer. Chem. Soc., Vol. 81, No. 11, 2659-62 (June 5, 1959).

The conductance of solutions of 1—1 electrolytes descreases with increasing concentration because the mobility of the ions is decreased due to the action of long range interionic forces and because the concentration of free ions decreases due to association increasing with concentration. A conductance equation based on these effects is derived; it is applicable to 1—1 electrolytes in solvents of dielectric constant greater than about 15, at concentrations up to that corresponding to $\kappa a \cong 0.2$ (a = ionic diameter, κ = Debye—Hückel parameter). In solvents of high dielectric constant, the equation reduces to Onsager's limiting tangent while in solvents of low dielectric constant, it transforms into the classical Ostwald dilution law. In the intermediate range of dielectric constant, previously inaccessible to theoretical analysis, the equation describes conductance data in terms of three molecular parameters. The limiting conductance, the ion size and the association constant. Methods of applying the equation to experimental data are described.

541.135 : 535.343

8961. SPECTROPHOTOMETRIC DETERMINATION OF THE ELECTRON AFFINITY OF FLUORINE.

J.Jortner, G.Stein and A.Treinin.

J. chem. Phys., Vol. 30, No. 4, 1110-11 (April, 1959).

The authors consider the transition $Fe^{+3}X \rightleftharpoons Fe^{+2}X$ as taking place due to solvation,and to direct absorption of light. The resulting equation connecting the thermochemical data and the maximum frequency of light absorbed is examined for the cases of X^- being Cl^-, Br^-, and OH^- and the results used to estimate the electron affinity of F^- as 82 ± 2 kcal. P.Young

541.135

8962. POLYELECTROLYTES. S.A.Rice.

Rev. mod. Phys., Vol. 31, No. 1, 69-83 (Jan., 1959).

The theory of polyelectrolyte solutions is reviewed with emphasis on the basic physical processes. A general survey of the development of current ideas on the subject is followed by a summary of the mathematical theory of rigid polygons. Macromolecules which contain both positive and negative charges on their surfaces (polyampholytes) are treated separately and this section is followed by a discussion of flexible polyelectrolytes. The final section deals with the theory of electrostatic forces as the motive force for molecular transitions. J.Iball

541.135.5 : 537.311.33

8963. ELECTROCHEMISTRY OF THE SEMICONDUCTOR—ELECTROLYTE ELECTRODE. I. THE ELECTRICAL DOUBLE LAYER. M.Green.

J. chem. Phys., Vol. 31, No. 1, 200-3 (July, 1959).

The thermodynamics of the semiconductor—electrolyte electrode (S/C—E electrode) are examined. The following is concluded about the distribution of the p.d. due to excess charge V in the interphase (assuming the dipole distribution to be invariant with semiconductor electron concentration): (1) for a semiconductor, with a nondegenerate free carrier distribution throughout and no surface states, in contact with a concentrated electrolyte solution (such that the Gouy layer p.d. → 0), most of V occurs within the semiconductor phase and the p.d. across the compact Helmholtz layer is small (millivolts) Changes in p.d. across the S/C—E electrode caused by an externally applied p.d. will occur mainly in the S/C phase (if the electrolyte is concentrated); (2) for a S/C—E electrode with a high concentration of ionized surface states of one kind, p.d. caused by excess charge in the Helmholtz layer, H will be large (~ 1 volt) and the electrode behaves like a metal electrode. The Helmholtz layer p.d., H, is found to be essentially independent of bulk S/C electron concentration. An applied p.d. is mainly manifest across the Helmholtz layer (when the electrolyte solution is concentrated).

541.135.5

8964. CONSTRUCTION AND CHARACTERISTICS OF TEFLON-COVERED POLAROGRAPHIC ELECTRODE FOR INTRAVASCULAR OXYGEN DETERMINATION. J.Krog and K.Johansen.
Rev. sci. Instrum., Vol. 30, No. 2, 108-9 (Feb., 1959).

A combined silver—silver chloride platinum polarographic electrode mounted in a heart catheter is described. The advantage and characteristics of this particular construction are discussed.

PHOTOCHEMISTRY
RADIATION CHEMISTRY

541.14

8965. C^{13} AND DEUTERIUM ISOTOPE EFFECTS IN THE PHOTOLYSIS OF METHYL AND ETHYL BROMIDE.
A.A.Gordus and R.B.Bernstein.
J. chem. Phys., Vol. 30, No. 4, 973-6 (April, 1959).

Relative rates of formation of isotopic radicals in the photolysis of gaseous methyl and ethyl bromide were measured. Photolyses (2537 A) were carried out in a large excess of cyclopentane. Methyl (or ethyl) radicals formed in the primary C—Br bond scission abstract H from cyclopentane to form methane (or ethane). For methyl bromide, the C^{12}/C^{13} enrichment factor for the first fraction of the methane was 1.039 ± 0.003. The corresponding factor for the α-carbon—Br rupture in ethyl bromide was 1.041 ± 0.004. In the deuterium experiments, $CH_3Br—CD_3Br$ mixtures in excess cyclopentane were photolyzed. The H/D fractionation factor (based on CH_4/CD_3H) was 1.41 ± 0.01. The difference in rates of formation of isotopic radicals is due to the difference in ultraviolet absorption coefficients of the isotopic alkyl bromides. At 2537 A the observed ratio of the extinction coefficient of CH_3Br relative to that of CD_3Br is 1.38 ± 0.05.

541.14 : 535.343

8966. OPTICAL ABSORPTION STUDIES OF THE VOLUME PHOTOLYSIS OF LARGE SILVER CHLORIDE CRYSTALS.
F.Moser, N.R.Nail and F.Urbach.
J. Phys. Chem. Solids, Vol. 9, No. 3-4, 217-34 (March, 1959).

The exposure-induced volume darkening of large AgCl crystals has been studied at very low exposure levels, in both pure crystals containing known concentrations of cationic impurities. It has been found that the volume photoproduct that can be produced may be controlled by such impurities, of which cuprous ion is a striking example. The cuprous ion apparently provides deep hole traps at room temperature, thereby allowing the photoprocess to proceed with unit quantum efficiency until these traps have been filled. In the purest crystals grown, the volume darkening saturated at optical densities, measured at the peak of the absorption band, of less than 0.001 per cm thickness. The addition of 5×10^{16} cuprous ions per cm^3 allows the volume darkening to proceed to optical densities 1000 times higher. The shape of the exposure-induced absorption band is approximately constant over this range of densities, suggesting that there is no marked change in the size and distribution of the photoproduct centres as their number increases. In addition to photochemical effects, certain cationic impurities (particularly the elements commonly classed as Group VIIIA) produce impurity absorption bands in the silver halides whose intensity and shape may depend on the valence state of the impurity.

541.15

8967. MEASUREMENT OF THE RECOMBINATION OF H AND OH IN γ-IRRADIATED AQUEOUS SYSTEMS. T.J.Hardwick.
J. chem. Phys., Vol. 31, No. 1, 226-31 (July, 1959).

Differences in radical and molecular yields in γ-irradiated light and heavy water solutions have been measured over the range of sulphuric acid concentration 0-0.8 N. Three new terms have been defined: G_H^* and G_{OH}^*, which represent the hydrogen atoms and hydroxyl radicals which recombine to reform water; $G_{-H_2O}^I$, which represents the gross number of water molecules decomposed into radicals. A model of radical formation and diffusion has been developed from which values of G_H^*, G_{OH}^*, and $G_{-H_2O}^I$ may be calculated from the experimental data.

541.15

8968. ESTIMATION OF CHAIN FRACTURE DURING THE CROSS-LINKING OF RUBBER HYDROCARBONS BY HIGH-ENERGY RADIATION. L.Mullins and D.T.Turner.
Nature (London), Vol. 183, 1547-8 (May 30, 1959).

The fracture of purified natural rubber exposed in vacuo to a 4 MeV electron beam was studied, using three methods: (1) measurement of the solubility of the irradiated polymer; (2) stress relaxation measurements during irradiation; (3) simple extension stress—strain measurements. No quantitative analysis of the solubility data was attempted, but approximate values of 0.14 and 0.11 for the ratio of fractures to cross-links were obtained from the stress relaxation and stress—strain measurements respectively.
B.J.Wilson

541.15

8969. CHEMICAL EFFECTS OF LOW ENERGY ELECTRONS.
R.R.Williams, Jr.
J. phys. Chem., Vol. 63, No. 6, 776-80 (June, 1959).

A new technique has been developed for the study of chemical decomposition of gases by low energy electrons. Ultraviolet light falling on a silver surface generates photoelectrons which are accelerated in the gas by application of an electric field. The electron yields products formed by irradiation of methane and ethane have been examined as a function of applied potential and the behaviour of the systems suggests than at important primary process non-ionizing excitation by electron impact.

541.15 : 539.17

RADIATION EFFECTS ON ORGANIC LIQUIDS OF POSSIBLE USE IN NUCLEAR REACTORS. See Abstr. 8658

DISPERSIONS . COLLOIDS . ADSORPTION

541.18 : 537

8970. A STUDY ON MICELLE FORMATION IN COLLOIDAL ELECTROLYTE SOLUTIONS. C.Botré, V.L.Crescenzi and A.Mele.
J. phys. Chem., Vol. 63, No. 5, 650-3 (May, 1959).

Membrane electrodes of both negative and positive type were used to determine the activity of counterions in aqueous solutions of cationic and anionic detergents. The method was found to be a useful tool to determine the critical concentration for micelle formation. An evaluation of the degree of association between micelles and counterions from the experimental activity coefficients has indicated that the strong electrostatic field of the charged micelles tends to bind a large fraction of counterions. A simple treatment of soap micelles as polymeric electrolytes was considered.

541.18.041

8971. CONCENTRATION-DEPENDENT SEDIMENTATION IN TWO-COMPONENT SYSTEMS, WITH REFERENCE TO DIFFERENTIAL BOUNDARIES. H.Fujita.
J. chem. Phys., Vol. 31, No. 1, 5-11 (July, 1959).

It is shown that if a sedimentation velocity experiment is performed on a binary system using an initial boundary formed between solutions of slightly different concentrations, the observed data can be analysed to evaluate s and D for any type of concentration dependence of s; here s is the sedimentation coefficient of the solute and D is the diffusion coefficient of the system. The Lamm differential equation for sedimentation of a single, homogeneous solute in the ultracentrifuge cell is solved in closed form by employing approximations which are appropriate under this initial condition. Equations for the movement of the boundary gradient curve and its height—area ratio are derived from the approximate solution obtained. From these equations, procedures are developed which permit determination of the values of s and D for the mean concentration of the two starting solutions and the first derivative of the dependence of s on concentration at this composition.

541.18.041 : 539.219

8972. THEORY OF DIFFUSION-LIMITED PRECIPITATION.
F.S.Ham.
J. Phys. Chem. Solids, Vol. 6, No. 4, 335-51 (Sept., 1958).

A simple theory for diffusion-limited general precipitation from a supersaturated solution upon an array of particles is described. The time-dependence is calculated of the unprecipitated fraction of the excess solute for small spherical, spheroidal and cylindrical particles. This fraction has the form $\exp(-bt^n)$ for small t. If the particles grow from initially negligible dimensions with constant eccentricity, and the growth is entirely diffusion-limited, then $n = \frac{3}{2}$ for all spheroids, including rods and disks as well as spheres. This contrasts with earlier evaluations, which gave $n = \frac{5}{2}$ for disks and n = 2 for rods and which are incorrect; n = 1 for cylindrical particles. Also, n is 1 for small disks and rods, of finite initial dimensions, that remain highly eccentric and do not alter their longer dimensions appreciably during growth. Regardless of particle shape, the unprecipitated fraction is given approximately by $[G \exp(-at)]$ when the fraction is less than $\frac{1}{2}$. An exact solution is given of the time-dependent diffusion equation for the growth of a spheroidal particle in an infinite medium, and it is shown that under strictly diffusion-limited conditions the particle grows with constant eccentricity and that its dimensions are proportional to $\sqrt{t}$.

541.182

8973. SIMPLE TECHNIQUE FOR GENERATION OF HOMOGENEOUS MILLIMICRON AEROSOLS.
S.C.Stern, J.S.Baumstark, A.I.Schekman and R.K.Olson.
J. appl. Phys., Vol. 30, No. 6, 952-3 (June, 1959).

Aerosols of low dispersion were obtained by evaporating a cloud of droplets containing involatile particles of known size. The particles were T3E coliphage or Type 3 poliomyelitic virus. They were suspended in particle-free water and atomized with particle-free air. Removal of contaminants from air, water, phage and virus suspensions is described. The phage aerosol had number median diameter of 35 mμ and geometric standard deviation of 1.4 mμ. The virus aerosol had number median diameter of 26 mμ and geometric standard deviation 1.3 mμ. E.R.Wooding

541.182 : 531.715 : 551.575

DETECTING VOLATILE AIRBORNE DROPLETS.
See Abstr. 7692

541.182.6 : 535.343

8974. DETERMINATION OF PARTICLE SIZE AND CONCENTRATION FROM SPECTROPHOTOMETRIC TRANSMISSION.
J.B.Bateman, E.J.Weneck and D.C.Eshler.
J. Colloid Sci., Vol. 14, No. 3, 308-29 (June, 1959).

Specific extinctions E/c have been measured in the visible and long ultra-violet (3500-10 000 A) for four polystyrene latexes containing uniform spherical particles suspended in water, using a modified Beckman model DU spectrophotometer. Methods were developed for making the interpolations required in calculating the Mie total scattering coefficients $K(\lambda)$ from published tabulations of $[K(\alpha)]_m$. The values so obtained were in good agreement with those calculated from extinction, dry weight, and particle radii determined in the electron microscope (Abstr. 8366 of 1955). In reversing the procedure, values of particle radius could be found from the experimental data which agreed very well (to < 1% in 3 cases out of 4) with those determined by electron microscopy. In order to dispense with the need for independent concentration measurements, it was further shown that experimental slopes s, equal to $-(d \log E/d \log \lambda)$, agreed well with theoretical values equal to $d \log K/d \log \alpha$ (where α is the size parameter $2\pi r/\lambda$). Again reversing the procedure with the aid of suitable calibration curves s(log r) it was shown that particle size and concentration could both be determined from the experimental slope s, the former agreeing to better than 2% with the electron microscope values and the latter to better than 6% with the dry weights. Attention is drawn to the importance of the "fine structure" or presence of subsidiary extrema in the theoretical and experimental data s(r) when characterizing highly uniform monodisperse suspensions of spheres by this method.

541.183

8975. FIRST ADSORBED LAYER OF HELIUM AT 4.2°K.
J.P.Hobson.
Canad. J. Phys., Vol. 37, 300-12 (March, 1959).

An attempt has been made to measure the helium adsorption isotherm on pyrex (Corning 7740) at 4.2°K for pressures above the adsorbed layer ranging from 10^{-4} to 10^{-12} mm Hg. New ultrahigh vacuum techniques were used for the pressure measurements with geometric adsorbing areas from 10 to 70 cm². Above 10^{-9} mm Hg the results give a true measurement. Below 10^{-9} mm Hg the results give an upper limit on the pressure above the adsorbed layer. The form of the isotherm indicates that the first adsorbed layer is complete at a pressure $<10^{-9}$ mm Hg. A comparison of the present results with previous measurements of the helium adsorption isotherm at 4.2°K, which extend down to 10^{-6} mm Hg, suggests that all such measurements with solid adsorbents have been made on helium layers thicker than one monolayer, This conclusion supports similar conclusions drawn from heats of adsorption data at higher temperatures. An extrapolation of the results suggests that total gaseous densities approaching those of interstellar space (1.0×10^{-24} g/cm³) should be possible in the laboratory, with liquid helium trapping.

541.183 : 537.533

8976. ELECTRICAL PROPERTIES OF HYDROGEN ADSORBED ON SILICON. J.Eisinger.
J. chem. Phys., Vol. 30, No. 4, 927-30 (April, 1959).

The photoemission from a silicon surface was studied as a function of the number of hydrogen atoms adsorbed on it. The electric dipole moment of an adsorbed H atom is found to be $\sim 0.15 \times 10^{-18}$ e.s.u.

541.183

8977. SOME MEASUREMENTS OF ADSORPTION OF NITROGEN AND OXYGEN ON A (0001) TITANIUM SURFACE USING LOW-ENERGY ELECTRON DIFFRACTION.
T.H.George, H.E.Farnsworth and R.E.Schlier.
J. chem. Phys., Vol. 31, No. 1, 89-90 (July, 1959).

Both nitrogen and oxygen chemisorb on the clean (0001) surface of titanium in crystalline monolayers having the same hexagonal symmetry and lattice constants as that of the titanium surface, but with different distances between the surface titanium plane and the gas planes. Adsorption as a function of exposure was determined for both gases. An average sticking coefficient for nitrogen at room temperature of about 1.8×10^{-8} was obtained.

541.183

8978. INFLUENCE OF LATTICE-DEFECT DENSITY ON THE CHEMISORPTION AND OXIDE FORMATION ON A CLEAN (100) CRYSTAL FACE OF NICKEL AS DETERMINED BY LOW-ENERGY ELECTRON DIFFRACTION. H.E.Farnsworth and J.Tuul.
J. Phys. Chem. Solids, Vol. 9, No. 1, 48-56 (Jan., 1959).

An atomically clean, carbon-free, (100) single-crystal face of nickel was obtained by outgassing in high vacuum, argon-ion bombardment, and subsequent annealing. As the exposure to oxygen was increased from 10^{-8} mm Hg min at 25°C, adsorption occurred first in a double-spaced, face-centred, crystalline lattice, then in a single-spaced, simple-square lattice, and finally in a nickel-oxide lattice. The intensities of the diffraction patterns from the adsorbed structures were much greater for a surface having a high defect density than for one having a low defect density, although the exposures required to produce detectable amounts of the structures were approximately independent of the defect density. These intensities from the chemisorbed lattice structures were much greater when the exposures were made at 150° than at 25°C, and the structures were stable for higher exposures at the higher temperature. Concequently, larger oxygen exposures were required to form a detectable amount of oxide at 150° than at 25°C. The exposures required to produce detectable amounts of chemisorbed lattice structures did not vary appreciably with temperature in this range. Most of the adsorption and oxidation measurements were made in the exposure range 10^{-8} to 10^{-4} mm Hg min. Certain exposures and subsequent heat treatments resulted in additional lattice structures.

541.183

8979. TESTS WITH LOW-ENERGY ELECTRON DIFFRACTION FOR ADSORBED HYDROGEN AND NICKEL HYDROXIDE FORMED ON THE (100) SURFACE OF A NICKEL CRYSTAL AT 25°C.
H.E.Farnsworth, R.E.Schlier and J.Tuul.
J. Phys. Chem. Solids, Vol. 9, No. 1, 57-9 (Jan., 1959).

A low-energy electron-diffraction pattern from a chemisorbed double-spaced mono-layer was observed subsequent to an exposure to hydrogen, only when a hot filament was present during the exposure, thus indicating adsorption of atomic hydrogen or water vapour or both. Evidence is presented which indicates that this double-spaced structure was due to water vapour. Adsorption of hydrogen on some parts of the surface, with no hot filament present during exposure, was confirmed by consecutive exposures of the clean nickel surface to hydrogen and oxygen to form Ni(OH)$_2$.

541.183

8980. THE EFFECT OF THE SPREADING SOLVENT ON THE PROPERTIES OF MONOLAYERS. V.K.La Mer and M.L.Robbins.
J. phys. Chem., Vol. 62, No. 10, 1291-5 (Oct., 1958).

Archer and La Mer have reported that the resistances exhibited by fatty acid monolayers to the evaporation of the aqueous subphase are sensitive to the nature of the spreading solvent and the techniques used in spreading. They attribute these effects to holes produced by solvent molecules occluded in the monolayer. More recently, Ries and Cook report that the surface pressure-area (π-a) isotherm for stearic acid shows similar sensitivity to the specific spreading solvent used. They find a variation in curvature in the low pressure region. The present authors have investigated the effect upon the π-a isotherm produced by varying the concentration of stearic acid in a benzene spreading solution. The slope and limiting area of the liquid condensed region are dependent upon the concentration of the spreading solution but are independent of the volume of solution delivered to the surface, the initial area of the surface, or the time allowed for benzene to evaporate. Correlations between these findings and those of Archer and La Mer are indicated. The formation of a mixed monolayer of stearic acid and benzene is proposed as a model to explain our observations.

CHEMICAL ANALYSIS

545.71

8981. METHOD OF INCREASING THE SENSITIVITY AND STABILITY OF THERMISTOR THERMAL-CONDUCTIVITY GAS ANALYSERS. R.E.Walker.
Rev. sci. Instrum., Vol. 30, No. 5, 378 (May, 1959).

This consisted in designing the cell so that it could be immersed in a crushed ice and water bath. Instrument instability due to ambient temperature variation was greatly reduced and because of the lower temperature of 0°C and the consequent increase in resistance of the thermistors the instrument sensitivity was increased by a factor of two. Another modification incorporating a Cartesian vacuum manostat enables the sample to be analysed to be continually withdrawn through a small probe from a supply at subatmospheric pressure. W.Good

545.824

8982. X-RAY SPECTROGRAPHIC DETERMINATION OF STRONTIUM. J.T.Campbell and H.I.Shalgosky.
Nature (London), Vol. 183, 1481 (May 23, 1959).

Describes improvement in X-ray fluorescence technique of measuring strontium in bone or milk ash. Ten parts per million of strontium can be determined in half an hour with a statistical accuracy of 10%. T.Mulvey

545.827

8983. STATISTICAL THEORY OF MASS SPECTRA: DIFFICULTIES IN INTERPRETATION OF SPECTRA OF THE LOWER ALKANES. L.Friedman, F.A.Long and M.Wolfsberg.
J. chem. Phys., Vol. 30, No. 6, 1605-8 (June, 1959).

Mass spectra of a group of normal alkanes, C_4 through C_8, were studied as a function of ionizing voltage. Appearance potentials have also been measured for most of the ions. At all voltages the yields of the ion fragment produced by loss of hydrogen atoms and by loss of methyl radicals are surprisingly low relative to their appearance potentials. Since for the lower ionizing voltages it can safely be assumed that there are no significant contributions to the patterns from secondary decompositions, these low yields must indicate a low intrinsic probability for the primary processes by which these ions are formed. For the typical case of n-pentane, the experimental data were analysed from the standpoint of the statistical theory of mass spectra and it is found that frequency factors in the ratio of $1:10^4:10^6$ must be proposed to account for the yields from the hydrogen atom : methyl radical : ethyl radical extraction processes at low ionizing voltages. The implications of this wide range of frequency factors are discussed briefly.

547.96

8984. CHEMICAL CHARACTERIZATION OF PROTEINS, CARBOHYDRATES AND LIPIDS. J.L.Oncley.
Rev. mod. Phys., Vol. 31, No. 1, 30-49 (Jan., 1959).

A summary of current knowledge of the chemical composition and structure of proteins, carbohydrates and lipids. J.Iball

547.96 : 539.19

MOLECULAR CONFIGURATION OF SYNTHETIC AND BIOLOGICAL POLYMERS. See Abstr. 8770

547.96 : 539.19

PROTEINS AND THEIR INTERACTIONS. See Abstr. 8776

CRYSTALLOGRAPHY

548.0 : 535.361.2

8985. THE SCATTERING OF LIGHT FROM METAL AVENTURINE SURFACE AND THEIR STATISTICAL MODELS.
H.Hasunuma and J.Nara.
J. Phys. Soc. Japan, Vol. 12, No. 10, 1117-22 (Oct., 1957).

The scattered light from Cr-plated aventurine surfaces was measured by a goniophotometer. The results were analysed assuming that the surfaces are covered by randomly distributed small facets and that the scattered light is reflected regularly by the facets. It is concluded that the inclinations of the facets are distributed by Gaussian process, the r.m.s. values of them lying between 4° to 10°. The results were compared with theoretical values calculated from the equi-inclination model.

548.24

8986. REVISED CALCULATION OF DEFORMATION TWINNING SYSTEMS. A.R.Rosenfield.
J. appl. Phys., Vol. 29, No. 12, 1771 (Dec., 1958).

A previous analysis by the author (Abstr. 3557 of 1958), attempting to disprove the critical resolved twinning stress hypothesis, is modified by making allowance for the algebraic sign of the twinning direction vector. The previous conclusion, that the available data does not support the critical resolved twinning stress hypothesis, is not changed by the revised calculations. R.Bullough

548.5 : 536.7

8987. CRYSTAL GROWTH AND THE THERMODYNAMICS OF IRREVERSIBLE PROCESSES. J.S.Kirkaldy.
Canad. J. Phys., Vol. 37, No. 6, 739-54 (June, 1959).

The principle of minimum rate of entropy production is applied to steady-state transport processes in the neighbourhood of an alloy crystal face growing into its melt. The procedure gives a satisfactory rationale of observed interface morphology. It is noted that segregation, which occurs in cellular or dendritic growth of alloys, is a direct manifestation of the system's attempt to minimize entropy production by conserving free energy. The general problems of growth of pure and impure single crystals from the melt and vapour are discussed.

548.5

8988. GROWTH PHENOMENA IN Ge CRYSTALS. G.Zielasek.
Z. Naturforsch., Vol. 13a, No. 12, 1097-8 (Dec., 1958). In German.

Miscellaneous observations are reported on the growth features (coarse and fine striations, surface pits) of crystals grown from the melt by the Czochralski procedure. B.T.M.Willis

548.5 : 537.531 : 535.33.07

8989. THE PERFECTION OF GERMANIUM CRYSTALS.
J.Bačkovský and R.Bubáková.
Czech. J. Phys., Vol. 7, No. 1, 124 (1957). In Russian.

Germanium crystals were prepared by drawing from a melt under vacuum using zone refined metal as starting material. Comparison of widths of X-ray reflections obtained from these crystals with theoretical calculations show that the crystals are nearly perfect. It is suggested that germanium crystals could be used in X-ray spectrometers particularly when intensity is of greater importance than resolving power. J.Adam

548.5 : 538.2

8990. THE GROWTH OF SINGLE CRYSTALS OF MAGNETIC GARNETS. J.W.Nielsen and E.F.Dearborn.
J. Phys. Chem. Solids, Vol. 5, No. 3, 202-7 (May, 1958).

Crystals of magnetic garnets, $Y_3Fe_5O_{12}$, $Sm_3Fe_5O_{12}$, $Er_3Fe_5O_{12}$, and $Gd_3Fe_5O_{12}$, suitable for many research purposes have been grown from iron-rich melts of lead oxide. A satisfactory composition is PbO 52.5, Fe_2O_3 44, and M_2O_3 3.5 mole per cent, where M is Y, Sm, Er, or Gd. Portions of the phase equilibrium diagrams for the systems $Fe_2O_3-YFeO_3$ and $PbO-Y_2O_3-Fe_2O_3$ have been approximately determined. All the data obtained concerning the growth of magnetic garnets are consistent with these diagrams.

548.5

8991. PRODUCTION OF SINGLE CRYSTALS OF FERRITES BY VERNEUIL METHOD. A.A.Popova.
Dokl. Akad. Nauk SSSR, Vol. 121, No. 3, 453-4 (July 21, 1958).
In Russian.

Crystals 7-8 mm in diameter and up to 5 cm, or occasionally 9 cm, in length were grown in oxyhydrogen flame. J.Adam.

548.5

8992. ON THE GROWTH OF GALLIUM ARSENIDE CRYSTALS FROM THE MELT. S.G.Ellis.
J. appl. Phys., Vol. 30, No. 6, 947-8 (June, 1959).

Describes the development in a radial direction of planar surfaces on a crystal being pulled from the melt when the pull rate was reduced to zero. The symmetry indicates that the equilibrium form is tetrahedral and that this is related to polarity of this material along the ⟨111⟩ axis. W.Bardsley

548.5 : 537.311.33

8993. THE PREPARATION AND PROPERTIES OF GALLIUM ARSENIDE SINGLE CRYSTALS. J.M.Whelan and G.H.Wheatley.
J. Phys. Chem. Solids, Vol. 6, No. 2-3, 169-72 (Aug., 1958).

The preparation of single crystals by the floating-zone method is described. These crystals have resistivities in the range 10^{-2}-10^{6} ohm cm. The Hall coefficient and conductivity were measured for five n-type samples in the temperature range 50 to 900°K. An impurity level 0.54 ± 0.05 eV below the conduction band is believed to be responsible for the high-resistivity sections of the crystals. The highest electron mobility ($R\sigma$) measured at room temperature is 6000 $cm^2\ sec^{-1}\ V^{-1}$. The energy gap is estimated to be 1.58 ± 0.05 eV at 0°K.

548.5

8994. GROWING $BaTiO_3$ SINGLE CRYSTALS. A.M.Cherepanov.
Zh. tekh. Fiz., Vol. 27,No.10, 2280-4 (Oct., 1957). In Russian.
English translation in: Soviet Physics — Technical Physics (New York), Vol. 2, No. 10, 2119-22 (Oct., 1957).

Describes modifications to methods for the production of single crystals of $BaTiO_3$. "Certain other materials" (not specified) are added to the mix. J.Thewlis

548.5

8995. PRODUCTION OF ZINC OXIDE SINGLE CRYSTALS OF DEFINITE COMPOSITION. G.Bogner and E.Mollwo.
J. Phys. Chem. Solids, Vol. 6, No. 2-3, 136-43 (Aug., 1958).
In German.

A method is given by which the crystals can be deposited from the gas phase. Measurements on the composition, conductivity, and infrared absorption of crystals doped with copper or indium are discussed.

548.5

8996. A METHOD FOR THE GROWING OF ALKALI-HALIDE-PHOSPHORS FOR SCINTILLATION COUNTERS.
L.M.Shamovskii, L.M.Rodionova and A.S.Glushkova.
Izv. Akad.Nauk SSSR, Ser. fiz.,Vol. 22, No. 1, 3-11 (1958). In Russian.
English summary : PB141041T-1, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

Alkali halide crystals were grown in sealed quartz tubes in a Stockbarger furnace. Measurements were made of the distribution of Tl activator. The effect of annealing on crystal structure is discussed. J.Franks

548.5 : 541.183

8997. THE EFFECT OF ADSORPTION ON THE FACE DEVELOPMENT OF THE EQUILIBRIUM FORM. P.Hartman.
Acta cryst., Vol. 12, Pt 6, 429-39 (June, 1959).

The effect of adsorption on zonal development is discussed. The surface energy of a face (hk0) on which foreign particles are adsorbed is expressed in terms of the surface energies of the two most densely packed faces (100) and (010) and the interaction energies of the adsorbed particles with the crystal chains parallel to [001]. For non-ionic crystals it is found that the face (110) is fairly enhanced if the adsorption takes place at the step edges only. If the adsorption takes place on the whole surface, its effect on the equilibrium form is slight. For ionic crystals the effects are larger and several examples are studied. To this end approximate formulae are derived for the interaction energy of various types of ionic chain. It was found that adsorption can lead to an abnormal face development of the zone, so that faces with relatively high indices become rather persistent. The high index forms studied include {532} of zircon, {017} and {3,2,19} of anatase, {123}, {124}, {137} and {3,5,11} of fluorite. These faces are all parallel to the direction in which the interaction energy of the crystal ionic chains is zero. A tentative explanation of this effect is given. For zircon and anatase possible sites for adsorbed foreign ions are found.

548.5

8998. STABILIZATION OF SILICON SURFACES BY THERMALLY GROWN OXIDES. M.M.Atalla, E.Tannenbaum and E.J.Scheibner.
Bell Syst. tech. J., Vol. 38, No. 3, 749-83 (May, 1959).

A study has been carried out of the stability of silicon surfaces when they are provided with a chemically bound solid—solid interface. Stable surfaces have been obtained with the system silicon—silicon dioxide when the oxide is thermally grown. This latter system has been studied in some detail. The following phases of the investigation are presented: (1) some aspects of the thermal oxidation process and properties of the oxide; (2) the electronic properties of the resulting silicon—silicon dioxide interface; (3) the application of the process to devices and resulting device characteristics.

548.5

8999. NORMAL GRAIN GROWTH IN ZONE-REFINED HIGH-PURITY METALS. E.L.Holmes and W.C.Winegard.
Canad. J. Phys., Vol. 37, No. 4, 496-8 (April, 1959).

Comparisons are made between theoretical and experimental rates of boundary migration during grain growth in zone-refined metals; these indicate that a single-atom process is involved. A model is proposed for the mechanism of grain-boundary migration based on the assumption of a single-atom process and the fact that the energies of activation for grain growth, both in zone-refined lead and tin, are similar to the energy barrier to be overcome by an atom in transferring from the solid to the liquid state during melting.

548.5

9000. ON THE GROWING OF SPECTROMETRIC CRYSTALS ACCORDING TO THE METHOD DEVELOPED BY KYROPOULOS. L.M.Belyaev, U.P.Panova, V.A.Perl'shtein, V.V.Chadaeva and I.N.Tsigler.
Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 22, No. 1, 21-2 (1958). In Russian. English summary : PB141041T-1, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

Crystals of NaI activated with TlI were grown by the Kyropoulos method in a hermetically sealed furnace. The activator losses in open and sealed furnaces were compared. J.Franks

548.5

9001. PREPARATION AND CRYSTALLOGRAPHIC PROPERTIES OF THE SYSTEMS $LaMn_{1-x}Mn_xO_{3+\lambda}$ AND $LaMn_{1-x}Ni_xO_{3+\lambda}$ JA-1106.
A.Wold and R.J.Arnott.
J. Phys. Chem. Solids, Vol. 9, No. 2, 176-80 (Feb., 1959).

Lanthanum manganese oxides containing varying percentages of Mn^{+4} were prepared and their cell dimensions determined. Lanthanum manganese oxide, prepared under pure nitrogen, contained 0.02% Mn^{+4}. At room temperature it possessed orthorhombic symmetry and was the most distorted member of the series. The orthorhombic-to-rhombohedral transition points for members of this series have been determined, and the shape of the resulting curve interpreted on the basis of an ordering of four, coplanar empty orbitals of the Mn^{+3} ions and steric effects. The system $LaNi_xMn_{1-x}O_{3+\lambda}$ has been prepared and its crystallographic properties studied. La_2NiO_4, $LaNiO_3$ and an intermediate lanthanum nickel oxide were prepared and their X-ray data are given.

548.5

9002. TWO-PHASE GERMANIUM–ZINC "WHISKERS".
F.A.Trumbore and C.R.Isenberg.
J. appl. Phys., Vol. 30, No. 5, 795-6 (May, 1959).

The filaments, similar in form to conventional whiskers, were formed when small Ge–Zn droplets (~ 0.1 to 5 mm dia.) were allowed to cool. The mechanism of growth involves the extrusion of liquid alloy through a small hole in the outer shell followed by the nucleation and growth of a shell of germanium which serves as a nucleus for further orientated growth as extrusion continues. The filaments grow in the $\langle 111 \rangle$ direction. W.Bardsley

548.5

9003. ON THE CRYSTAL PERFECTION OF IRON WHISKERS.
P.D.Gorsuch.
J. appl. Phys., Vol. 30, No. 6, 837-42 (June, 1959).

The density and distribution of dislocations in tip grown iron whiskers produced by the hydrogen reduction of liquid iron halide salts has been measured by means of X-ray rocking curves. The data show that the more perfect whiskers have dislocation densities below 10^6 dislocation lines per cm^2. Thus, many of these whiskers which are less than 10 μ in diameter would contain, at most, only a small number of dislocations and should behave as perfect crystals. No evidence of a large elastic twist was found in any of the whiskers as would be expected for a whisker grown by a screw dislocation mechanism. This did not completely prove that iron whiskers must grow, therefore, by a mechanism based on coherent two-dimensional nucleation as there are combinations of specific types of screw dislocations which will not produce elastic twists in the whiskers.

548.5

9004. TWIST IN LITHIUM FLUORIDE WHISKERS. G.W.Sears.
J. chem. Phys., Vol. 31, No. 1, 53-4 (July, 1959).

Eshelby twists (Abstr. 3711 of 1953; 3518 of 1958) were observed microscopically on very fine lithium fluoride whiskers grown from aqueous solution.

548.5 : 539.374

STRENGTH OF GOLD WHISKERS. See Abstr. 8933

548.5

9005. TWO-DIMENSIONAL NUCLEATION OF NONCOHERENT LAYERS. G.W.Sears.
J. chem. Phys., Vol. 31, No. 1, 157-8 (July, 1959).

The kinetics of nucleating noncoherent layers on a parent crystal lattice are considered. The results are applied to perfect crystal growth. It is found that the maximum probability of growing a perfect crystal exists when growth occurs from a parent phase in contact with which the appropriate edge energy for two-dimensional nucleation is least.

548.5

9006. PREPARATION OF [SMALL] CRYSTALS OF InAs, InP, GaAs, AND GaP BY A VAPOR PHASE REACTION.
G.R.Antell and D.Effer.
J. Electrochem. Soc., Vol. 106, No. 6, 509-11 (June, 1959).

The vapour was composed of the monochloride or mono-iodide of the metal and phosphorus or arsenic. Crystal growth took place at from 100° to 300°C below the melting points of the compounds. Whiskers of InAs up to 2 cm long also have been grown.

548.5

9007. EPITAXIAL GROWTH OF THIN EVAPORATED METALLIC FILMS ON CLEAVAGE SURFACES OF ALKALI-HALIDES AND OTHER CRYSTALS. K.R.Dixit.
Indian J. Phys., Vol. 31, No. 2, 117-20 (Feb., 1957).

A theory of epitaxial growth of evaporated metal atoms is given. It is shown that the observed crystal structure and the orientation will be the combined result of the forces of temperature orientation and the attractive forces of the van der Waals' type.

548.5 : 537.529

DENDRITE GROWTH ON ROCK SALT AT 200° AND 300°C. See Abstr. 8191

548.5

9008. CHEMICAL ETCHING OF SILICON. I. THE SYSTEM HF, HNO_3, AND H_2O. H.Robbins and B.Schwartz.
J. Electrochem. Soc., Vol. 106, No. 6, 505-8 (June, 1959).

The kinetics of the etching of silicon in the system HF, HNO_3, and H_2O was studied as a function of the composition of the etchant at 25°C. A triaxial plot of the etch rate v. composition of the etchant shows two extreme modes of behaviour. In the region of high nitric acid compositions, etch rates are functions only of the hydrofluoric acid concentration. In the region of high hydrofluoric acid compositions, nitric acid concentration determines the etch rates. The kinetic behaviour in the latter region is complicated by autocatalysis in which the reduction products of nitric acid are involved. The reaction proceeds by an oxidation step followed by the dissolution of the oxide. In the high hydrofluoric acid region the oxidation step is rate limiting. In the high nitric acid region the dissolution step is rate limiting. In both regions the flow of reagent to the surface by diffusion determines the etch rates. A plot of the etch rates as a function of the concentration of the rate-limiting reagent indicates an exponential relationship between the etch rates and the concentration. This relationship has been explained qualitatively on the basis of a second, nonchemical autocatalytic factor, the heat of reaction.

548.5

9009. INVESTIGATION OF INDUSTRIAL ETCHING OF THE SURFACE OF GERMANIUM SINGLE CRYSTALS PREPARATORY TO APPLYING MOLTEN INDIUM.
R.E.Smolyanskii, V.M.Gurevich, A.M.Raikhlin and M.I.Lukasevich.
Zh. tekh. Fiz., Vol. 28, No. 10, 2135-41 (1958). In Russian.

A mixture of 8-10 ml 25% NaOH solution with 1000 ml 30% H_2O_2 solution was found to be a most effective etching reagent for Ge. A thin layer of GeO_2 formed during etching (not soluble in the etchant) is easily dissolved by hot (80-90°C) distilled water. Since the distorted surface layer of a Ge single crystal cut with a steel blade is approx. 90 μ thick, at least 3 etching operations, each followed by a rinse in hot, distilled water, are necessary for its complete removal. The following explanation of different absorptive powers of Ge specimens etched with alkaline and acid reagents is suggested: owing to a larger effective surface area of Ge etched in an alkaline reagent, it absorbs 9 times the quantity of gases absorbed after an acid etch, while the increased proportion of absorbed water is due to the presence of the Na^+ ions. M.H.Sloboda

548.5

9010. DISLOCATION ETCH TECHNIQUES FOR SOME ALKALI HALIDE CRYSTALS. P.R.Moran.
J. appl. Phys., Vol. 29, No. 12, 1768-9 (Dec., 1958).

A description is given of etchants and etching conditions that enable relative densities of dislocations in NaCl, KCl, KBr and KI crystals to be determined. R.F.Peart

548.574

9011. ETCH PITS ON CALCITE CLEAVAGE FACES.
R.C.Stanley.
Nature (London), Vol. 183, 1548 (May 30, 1959).

The shapes and contours of etch pits on faces cut parallel to the cleavage plane or to the optical axis are described. B.T.M.Willis

X-RAY CRYSTALLOGRAPHY

548.73/.74

X-RAY AND ELECTRON INVESTIGATION OF MATERIALS. See also the Section entitled "STRUCTURE OF SOLIDS".

548.732

9012. ESTIMATION OF THE ABSORBING POWER OF SINGLE CRYSTALS FOR WEAK AND MEDIUM ABSORPTION.
E.Frasson and S.Bezzi.
Acta cryst., Vol. 12, Pt 7, 536-40 (July, 1959).

An approximate method of quick application is described for the determination of the absorption of single crystals of low and medium absorbing power. The approximate formula can be generally applied with graphic method and even more rapidly with analytical method, should the crystal sections be regular and simple. Approximation errors are reduced by means of a nomogram.

548.732

9013. THE RESOLVING POWER OF SO-CALLED HIGH REFLECTION ANGLE X-RAY DIFFRACTION TECHNIQUE.
B.Ya.Pines, A.F.Sirenko and L.G.Mel'nik.
Zh. tekh. Fiz., Vol. 28, No. 10, 2344-7 (1958). In Russian.

Back-reflection X-ray patterns of Al, Fe, and Cu specimens were obtained using Co- and Fe-radiation. Contrary to the reports of some other workers, e.g. Gurevich and Ormont (Abstr. 1751 of 1957), no increase of the resolving power was observed, when the distance D between the film and the specimen was increased in the 90-750 mm range. No useful purpose was served by increasing D above 150 mm, since under these conditions good resolution was obtained at the cost of increased scattering of X-rays in air, with all its undesirable effects (strong background, longer exposures).
M.H.Sloboda

548.733

9014. X-RAY DIFFRACTION CAMERA FOR PRECISE MEASUREMENT OF THE UNIT CELL PARAMETERS OF SINGLE CRYSTALS RKM-114. S.S.Kvitka and M.M.Umanskiĭ.
Kristallografiya, Vol. 2, No. 5, 702-4 (1957). In Russian. English translation in: Soviet Physics — Crystallography (New York), Vol. 2, No. 5, 694-6 (Sept.-Oct., 1957).

548.733

9015. FURTHER DEVELOPMENT OF THE LIMITING CHAMBER FOR THE RECORDING OF SMALL-ANGLE X-RAY SCATTERING. G.E.R.Schulze and J.Henke.
Exper. Tech. der Phys., Vol. 5, No. 4, 180-3 (1957). In German.

See Henke and Schulze (Abstr. 4110 of 1959). A limiting chamber [Rahmenkammer] is described which is more than twice as sensitive as that of Kratky.
J.M.Hough

548.733

9016. ADAPTATION OF A FURNACE FOR X-RAY DIFFRACTOMETRY. M.Bernard and J.Jaffray.
J. Phys. Radium, Vol. 19, No. 6, 616 (June, 1958). In French.

Brief communication describing a furnace capable of maintaining a specimen at 600° for several hours. Aluminium windows allow easy passage of the X-ray beam from a conventional diffractometer.
T.Mulvey

548.733

9017. USE OF BALANCED FILTERS FOR AUTOMATIC RECORDING X-RAY DIFFRACTOMETER.
K.Tanaka, K.Katayama, J.Chikawa and H.Suita.
Rev. sci. Instrum., Vol. 30, No. 6, 430-4 (June, 1959).

Using balanced filters with an automatic recording X-ray diffractometer, almost the same effect of monochromatization as with a crystal monochromator was achieved. The detection efficiency of the balanced filters method was about 30, taking the value as 100 when no filter was used. The effective resolving time of the system involving the electronic circuits was about 5 μsec using a NaI scintillation counter as a detector. The Cu-target X-ray tube was operated on full-wave rectified 60 c/s 40 kV peak. The comparison with the other monochromatization methods is discussed.

548.734.3

9018. THE DETERMINATION OF LATTICE CONSTANTS USING LOW ANGLE DIFFRACTION LINES. L.L.Hawes.
Acta cryst., Vol. 12, Pt 6, 443-5 (June, 1959).

Accurate lattice constants and interplanar spacings may be derived from low-angle reflections by using a modified camera geometry in recording the diffracted rays. Photographs thus produced require a substantially shorter exposure than those produced by conventional methods, and the technique lends itself to the elimination of the serious systematic errors which hitherto have rendered low-angle reflections unusable in lattice-constant work.

548.734.2

9019. POWDER PATTERN DIFFUSE INTENSITIES FROM MULTIPLE SCATTERING. B.E.Warren.
J. appl. Phys., Vol. 30, No. 7, 1111-12 (July, 1959).

A general formula is calculated for the intensity due to multiple Bragg reflections in a powder sample with random orientation. For the simplified case of a sample containing one kind of atom, the multiple scattering involving Compton modified and temperature diffuse intensities is taken into account. It is found that the intensity due to multiple scattering is weak enough to neglect in most cases.
C.Turner

548.735

9020. ON CRYSTAL ORIENTATION IN POLYCRYSTALLINE MATERIALS. Z.W.Wilchinsky.
J. appl. Phys., Vol. 30, No. 5, 792 (May, 1959).

The fibre texture in a polycrystalline material can be expressed in terms of $\langle \cos^2 \sigma \rangle_{av}$, where σ is the angle between a chosen crystallographic direction and a reference direction in the sample. It is shown how $\langle \cos^2 \sigma \rangle_{av}$ can be determined even if there are no reflecting planes normal to the chosen crystallographic direction.
B.T.M.Willis

548.735.2

9021. A UNIFIED PROGRAM FOR PHASE DETERMINATION, TYPE 2P. H.Hauptman and J.Karle.
Acta cryst., Vol. 12, Pt 7, 553-8 (July, 1959).

The new probability approach, in which the crystal structure is fixed and the Miller indices range uniformly but not independently over the integers, has yielded phase determining formulae with universal application to all the space groups. The formulation includes both the equal and unequal atom cases and takes special advantage of the symmetries characteristic of a particular space group. The present paper is concerned with the centrosymmetric space groups comprising type 2P. A detailed procedure for phase determination in this type is described.

548.735.4

9022. ON THE FOURIER TREATMENT OF DISTORTION BROADENING IN X-RAY DIFFRACTION. J.Gjønnes.
Acta cryst., Vol. 12, Pt 6, 439-42 (June, 1959).

General expressions for the Patterson function and intensity distribution in reciprocal space of a distorted crystal are derived. It is shown that the intensity distributions of the broadened reflections are given as sections through the six-dimensional Fourier transform of a strain distribution function. Relationship with earlier work and application to one-dimensional intensity distributions, such as powder diffractograms, are discussed.

548.735.4

9023. AN ACCOUNT OF SOME COMPUTING EXPERIENCES.
M.G.Rossmann, R.A.Jacobson, F.L.Hirshfeld and W.N.Lipscomb.
Acta cryst., Vol. 12, Pt 7, 530-5 (July, 1959).

Experience is summarized in the use of fractional shifts of scale, temperature and distance parameters, values of $r = \Sigma w(|F_O|^2 - |F_C|^2)^2/\Sigma w|F_O|^4$, the behaviour of temperature factors and a three-dimensional Patterson superposition programme in the determination of a number of structures.

548.735.4

9024. THE ALGEBRA OF STRUCTURE FACTORS. IV.
E.F.Bertaut.
Acta cryst., Vol. 12, Pt 7, 541-9 (July, 1959). In French.

For previous work, see Acta cryst., Vol. 10, Pt 9, 606 (Sept., 1957). The derivation of relations between structure factors in the case of equal atoms is systematized from a purely algebraic standpoint. Relations given by Cochran (Abstr. 11556 of 1954) and Hauptman and Karle (Abstr. 7531 of 1955) are particular cases of more general equations valid in each space group.

548.735.4 : 536.413

LATTICE PARAMETER VARIATION WITH TEMPERATURE IN SOLID CHLORINE. See Abstr. 8033

548.735.6

9025. STUDY OF THE MOSAIC STRUCTURE OF CRYSTALS.
J.Bačkovský and R.Bubáková.
Czech. J. Phys., Vol. 7, No. 1, 80-90 (1957). In German.

A double crystal monochromator (see Abstr. 6735 of 1957) was used to give a well collimated and highly monochromatic X-ray beam. The angular range of total reflection from a KCl crystal was determined and found to agree with Darwin's theory of dynamical reflection.
A.R.Stokes

548.736 : 536.631 : 537.311.31

9026. STUDY ON THE ORDERED ALLOY Ag_3Mg.
K.Fujiwara, M.Hirabayashi, D.Watanabe and S.Ogawa.
J. Phys. Soc. Japan, Vol. 13, No. 2, 167-74 (Feb., 1958).

One-dimensional anti-phase domain structure of the ordered alloy Ag_3Mg was confirmed by X-ray diffraction study using a single crystal as well as polycrystals and by electron diffraction study with evaporated thin films. Measurements of specific heat and electrical resistivity were also made, and these results were qualitatively discussed in connection with the structure of this alloy.

548.736

9027. X-RAY STUDIES ON THE STRUCTURES OF SOLID SOLUTIONS NaCl–CaCl$_2$. III. INFLUENCE OF HEAT TREATMENTS ON THE DIFFUSE REFLEXIONS OF X-RAYS DUE TO {111} AND {310} PLATE-ZONES. K.Suzuki.

J. Phys. Soc. Japan, Vol. 13, No. 2, 179-86 (Feb., 1958).

As reported in previous papers (see Abstr. 10094 of 1955), single crystals of solid solutions NaCl–CaCl$_2$ contain two kinds of plate-zones extending parallel to {111} and {310} planes of the matrix. The present study concerns with the change of these plate-zones by heat treatments at various temperatures. Single crystals of solid solutions NaCl–CaCl$_2$ containing 10 mole per cent CaCl$_2$, which have been made uniform solid solutions by pre-heating at 400° C (being slightly above the solid-solubility limit of the phase diagram of NaCl–CaCl$_2$ system), were aged at room temperature or heated at higher temperatures. It is found that the {310} plate-zone is stable only at low temperatures, while the {111} plate-zone is more stable at higher temperatures. As the heating temperature is raised, the {111} plate-zone gradually tends from a coherent structure to an incoherent structure. Rotating-crystal X-ray photographs for the crystal heat-treated at 300° C (being slightly below the solid-solubility limit of the phase diagram) reveal that the final products of the precipitation have the crystal structure of CaCl$_2$, with an orientation favouring the structure model of the {111} plate-zones proposed in Part II.

548.736.1

9028. X-RAY DIFFRACTION PATTERN FOR MONOCLINIC SULFUR. A.G.Pinkus, J.S.Kim, J.L.McAtee, Jr and C.B.Concilio.

J. Amer. Chem. Soc., Vol. 81, No. 11, 2652-4 (June 5, 1959).

Determined by making use of a special heated sample holder.

548.736.1

9029. STRUCTURE OF EPITAXED COPPER DEPOSITED BY EVAPORATION ONTO A CLEAN (00.1) FACE OF A TITANIUM CRYSTAL. R.E.Schlier and H.E.Farnsworth.

J. Phys. Chem. Solids, Vol. 6, No. 2-3, 271-6 (Aug., 1958).

The titanium crystal was cleaned by heating, ion-bombardment, and annealing in high vacuum. Low-energy electron diffraction was used to determine that the surface was essentially free of contamination and to make structure determinations. The copper deposits varied in average thickness from 0.5 to 25 atomic layers. The copper formed at nucleation centres in the form of discrete oriented crystallites with a lattice spacing parallel to the substrate which was the same as that of the (111) plane in bulk copper, and with the (110) azimuth of copper parallel to the (11.0) azimuth of titanium. No variation of lattice spacing with thickness was detected. Deposition of copper on a titanium surface, covered with a chemisorbed layer of oxygen, resulted in the formation of disoriented deposits at nucleation centres.

548.736.1

9030. THE CRYSTAL STRUCTURE OF GAMMA-SULFUR. Y.M.de Haan.

Physica, Vol. 24, No. 10, 855-6 (Oct., 1958).

Crystals were grown from solution in alcohol. They are monoclinic, P2/m; a = 8.57, b = 13.05, c = 8.23 A, β = 112° 54'; 32 atoms per cell, probably arranged in eight-membered rings. A.R.Stokes

548.736.3

9031. CRYSTAL STRUCTURE AND PHASE TRANSITION OF SOME METALLIC HALIDES. IV. ON THE ANOMALOUS STRUCTURE OF α-AgI. S.Hoshino.

J. Phys. Soc. Japan, Vol. 12, No. 4, 315-26 (April, 1957).

For Pt III, see Abstr. 10093 (1955). Intensities of X-ray diffraction from α-AgI at various temperatures were measured in the absolute scale by using a G.M. counter spectrometer with Cu Kα radiation. Measurements of the specific heat and the thermal expansion were also performed. A large temperature dependence of the intensities of Debye lines and the presence of a comparatively strong diffuse background were detected. The observed intensities of the Debye lines could be explained well by the disordered structure model (or the "averaged structure") proposed by Strock (Z. phys. Chem. B, Vol. 31, 132, 1936), assuming fairly large Debye factors for silver and iodine atoms. The intensity of the diffuse background from such an averaged structure was calculated in the similar way as in the case of binary alloys having short range order, assuming appropriate probability functions for the presence of atoms in different sites. It was confirmed that the intensity curves of the diffuse background measured at 250° and 400° C were in fair agreement with the theoretical ones. The nature of the "averaged structure" having the random arrangement of silver atoms and the origin of the large displacements of atoms from their equilibrium positions are discussed.

548.736.3

9032. EVIDENCE FOR A VARIABLE LONG-RANGE ORDER IN NEARLY ANHYDROUS GAMMA ALUMINA.

G.W.Brindley and M.Nakahira.

Nature (London), Vol. 183, 1620 (June 6, 1959).

A small-angle X-ray diffraction peak was observed from nearly anhydrous γ-alumina prepared from gibbsite. As dehydration neared completion the peak moved to smaller 2θ values and was finally lost in the direct beam. Thus a reproducible long-range spacing of 30-90A occurs for dehydration beyond 90% of completion.
B.T.M.Willis

548.736.3

9033. X-RAY METHOD FOR THE DIFFERENTIATION OF {111} SURFACES IN A^{III}B^{V} SEMICONDUCTING COMPOUNDS.

E.P.Warekois and P.H.Metzger.

J. appl. Phys., Vol. 30, No. 7, 960-2 (July, 1959).

Most of the A^{III}B^{V} semiconducting compounds have the zinc-blende crystal structure. This structure is noncentrosymmetric and as a consequence the moduli of F(hkl) and F($\bar{h}\bar{k}\bar{l}$), the geometrical structure factors, have different magnitudes. This difference results in a variation in the integrated intensities of certain X-ray reflection from opposite sides of samples taken from crystals with the zinc-blende structure. X-ray measurements of a series of {111} reflections from opposite sides of an InAs single crystal have been made and related to the etching characteristics of these surfaces.

548.736.3

9034. ON THE SUPERSTRUCTURE OF THE ORDERED ALLOY Cu$_3$Pd. II. X-RAY DIFFRACTION STUDY.

M.Hirabayashi and S.Ogawa.

J. Phys. Soc. Japan, Vol. 12, No. 3, 259-71 (March, 1957).

For Pt I, see Abstr. 4112 (1956). The structures of the ordered copper–palladium alloys in the composition range from 15.5 to 28.5 atomic % Pd were investigated by X-ray diffraction, using both single crystals and power specimens. The alloys with the composition of 20.8 to 25.8 atomic % have an anti-phase domain structure in a fully ordered state cooled slowly from 450° C to room temperature in four months. This structure is formed from the elementary face-centred tetragonal lattice, in which the atoms arrange themselves as in the ordered alloy Cu$_3$Au but step-shifts occur at a definite period along the tetragonal axis. On the other hand, the alloys of 27.3 and 28.5 atomic % Pd were confirmed to possess a more complicated anti-phase domain structure characterized by the two kinds of out-of-step, which was already elucidated by the electron diffraction study in Pt I. Variation of both the lattice parameters and the periods of anti-phase domain with composition were also studied.

548.736.3

9035. ON THE TEMPERATURE FACTOR e^{-2M} IN THE INTENSITY OF THE BRAGG MAXIMA IN THE CASE OF CHAIN-STRUCTURE CRYSTALS. V.V.Tarasov.

Zh. tekh. Fiz., Vol. 27, No. 10, 2398-403 (Oct., 1957). In Russian. English translation in: Soviet Physics — Technical Physics (New York), Vol. 2, No. 10, 2232-8 (Oct., 1957).

The mean square displacement of atoms in solid HF is calculated from specific-heat theory, and shown to agree with that found experimentally by Atoji and Lipscomb (Abstr. 5159 of 1954). It is noted that there is some confusion in the literature in the use of the term "mean square amplitude". A.R.Stokes

548.736.3 : 537.311.33

CRYSTAL STRUCTURE OF THE GROUP VB TO VIIB ELEMENTS AND OF COMPOUNDS FORMED BETWEEN THEM. See Abstr. 8101

548.736.3 : 538.2 : 537.311.33

CRYSTAL STRUCTURE OF RECTIFYING CUPROUS OXIDES. See Abstr. 8103

548.736.4

9036. THE CRYSTAL STRUCTURE OF PROTO-ENSTATITE, MgSiO$_3$. J.V.Smith.

Acta cryst., Vol. 12, Pt 7, 515-19 (July, 1959).

Proto-enstatite, at room temperature, is orthorhombic with 8 units of MgSiO$_3$ in a cell of dimensions a = 9.25, b = 8.74, c = 5.32 A, pseudo space group Pbcn. The atomic coordinates of the pseudo space group were determined from X-ray powder data. The SiO_3 chain is fully extended. One of the Mg atoms has an irregular coordination, which may be the reason for the instability of proto-enstatite at low temperature. The structure is very similar to that predicted by Atlas (1952).

548.736.4

9037. THE CRYSTAL STRUCTURE OF Sr_4PtO_6 AND TWO RELATED COMPOUNDS. J.J.Randall, Jr and L.Katz.

Acta cryst., Vol. 12, Pt 7, 519-21 (July, 1959).

The crystal structure of Sr_4PtO_6 was determined by a trial and error method. The crystals are trigonal with space group $R\bar{3}c$; the triply primitive hexagonal cell dimensions are a = 9.74, c = 11.90 A. The platinum ions are octahedrally coordinated with oxygen and are linked in the c direction through strontium ions surrounded by trigonal prisms of oxygens. These strings of coordination polyhedra are connected laterally by strontiums in eight-fold coordination with oxygen. This structure is of the same type as that reported for K_4CdCl_6. The isolation of one PtO_6 group from the next is postulated as a reason for the ease of hydrolysis of the compound. Sr_4IrO_6 and Sr_4RhO_6 have the same structure.

548.736.4

9038. STRUCTURE OF K_2CuF_4. NEW KIND OF DISTORTION FOR OCTAHEDRAL COPPER (II). K.Knox.

J. chem. Phys., Vol. 30, No. 4, 991-3 (April, 1959).

Potassium tetrafluorocuprate (II) was shown by single-crystal X-ray data to be isostructural with K_2NiF_4. The tetragonal unit cell, with a = 4.155 ± 0.005 and c = 12.74 ± 0.01 A, contains two formula units. The ions are in the following positions of space group $D_{4h}(17)$ - I4/mmm: 2Cu in (a), $4F_I$ in (c), 4K and $4F_{II}$ in (e) with $z_K = 0.356$ and $z_{FII} = 0.153$. In this structure the Cu(II) ions are surrounded by a distorted octahedron of F^- ions with two nearest neighbours at 1.95 A and 4 next nearest at 2.08. This is the first time that copper (II) in essentially octahedral coordination has been proved to have a tetragonal distortion such that c/a for the distorted octahedron is less than one. This experiental result is contrary to the theoretical calculations of Öpik and Pryce, but in accord with the refined computations of Liehr and Ballhausen.

548.736.4 : 538.2

9039. THE PREPARATION, CRYSTALLOGRAPHY, AND MAGNETIC PROPERTIES OF THE $Li_xCo_{(1-x)}O$ SYSTEM.

W.D.Johnston, R.R.Heikes and D.Sestrich.

J. Phys. Chem. Solids, Vol. 7, No. 1, 1-13 (Oct., 1958).

The $Li_xCo_{(1-x)}O$ system has been prepared by the solid-state reaction between Li_2O_2 and CoO at 900°C. The material is a single-phase structure in the composition range $0 < x < 0.2$, the lattice parameter of the cubic unit cell decreasing with increasing lithium content. At the composition x = 0.5 (i.e. $LiCoO_2$) a rhombohedral structure is formed. A phase diagram for this system has been developed. The crystal structure of material in the composition range $0 < x < 0.2$ has been studied both above and below the antiferromagnetic Curie temperature and the related cubic-tetragonal transformation are found to occur at decreasing temperatures with increasing lithium content. In addition the magnitude of the crystallographic deformation decreases and finally vanishes with increasing lithium content. The magnetic-susceptibility data indicate that the magnetic moment of Co^{+3} is best understood if the multiplet splitting is small compared to kT. Further, the moment of Co^{+3} is shown to be lowered by crystalline field effects. No effects attributable to the double exchange coupling were found. The absence of such a coupling is understood by consideration of the mechanism of electron transfer inthe lithium-substituted compounds.

548.736.4

9040. THE EFFECT OF DISPERSION CORRECTIONS ON THE REFINEMENT OF THE YTTRIUM–IRON GARNET STRUCTURE.

S.Geller and M.A.Gilleo.

J. Phys. Chem. Solids, Vol. 9, No. 3-4, 235-7 (March, 1959).

The refinement of the structure of yttrium–iron garnet has been recalculated with the inclusion of the previously neglected dispersion corrections on the atomic scattering factors of the metal atoms. No significant change is obtained in the positional parameters of the oxygen ions. Changes occur in the temperature factors of the yttrium and oxygen ions: for Y^{3+} from 0.16 to 0.40 A^2 and for O^{2-} from 2.05 to 1.19 A^2. There is also a change in the factor required to put the observed amplitudes on an absolute scale.

548.736.4

9041. CRYSTAL STRUCTURE OF SODIUM-POTASSIUM ANTIMONIDE (Na_2KSb). J.J.Scheer and P.Zalm.

Philips Res. Rep., Vol. 14, No. 2, 143-50 (April, 1959).

X-ray analysis of Na_2KSb has led to the determination of its crystal structure. The unit cell is described by the space group Fm3m-O_h^5 with four antimony atoms at $(0,0,0;\ 0,\frac{1}{2},\frac{1}{2};\ \frac{1}{2},0,\frac{1}{2},\ \frac{1}{2},\frac{1}{2},0) + 0,0,0$; four potassium atoms at $(\quad) + \frac{1}{2},\frac{1}{2},\frac{1}{2}$ and eight sodium atoms at $(\quad) + \frac{1}{4},\frac{1}{4},\frac{1}{4}$ and $\frac{3}{4},\frac{3}{4},\frac{3}{4}$. The crystal structure of Na_2KSb has a great resemblance to that of Cs_3Sb and differs strongly from that of Na_3Sb and K_3Sb, which both crystallize in the Na_3As type.

548.736.5

9042. AN APPLICATION OF LIPSON'S METHOD IN THE STUDY OF THE CRYSTAL SYSTEM OF $BaBOF_3$. D.M.Chackraburtty.

Indian J. Phys., Vol. 31, No. 5, 235-41 (May, 1957).

The substance was found to be orthohombic and the constants A, B and C were directly determined from the difference diagrams. Complete indexing was done, and from careful observations of the extinction of hkl planes the space group was assigned to be Pnma. The merits of Lipson's method are discussed in detail.

548.736.5

9043. CRYSTAL CHEMICAL STUDIES OF THE 5f-SERIES OF ELEMENTS. XXV. THE CRYSTAL STRUCTURE OF SODIUM URANYL ACETATE. W.H.Zachariasen and H.A.Plettinger.

Acta cryst., Vol. 12, Pt 7, 526-30 (July, 1959).

For previous work, see Abstr. 4168 (1955). Sodium uranyl acetate, $NaUO_2(O_2CCH_3)_3$, is cubic with space group $P2_13$ and a = 10.688 ± 0.002 A. The positions of all atoms were deduced from precisely measured X-ray diffraction intensities. In the collinear uranyl group U–O = 1.71 ± 0.04 A. Normal to the uranyl axis are six secondary bonds from uranium to acetate oxygens with U–O = = 2.49 ± 0.02 A. Sodium is bonded to six acetate oxygens with Na–O = 2.37 ± 0.04 A. The bond lengths within the acetate group are C–C = 1.52 ± 0.05 A, C–O = 1.26 ± 0.05 A and 1.28 ± 0.04 A, and 121° is found for the carboxyl bond angle. A revised bond length versus bond strength curve for U^{VI}–O bonds is presented.

548.736.5 : 538.2

CRYSTALLOGRAPHIC PROPERTIES OF SEVERAL SPINELS CONTAINING TRIVALENT JA-1044 MANGANESE. See Abstr. 8323

548.736.6

9044. A REFINEMENT OF THE CRYSTAL STRUCTURE OF DANBURITE. G.Johansson.

Acta cryst., Vol. 12, Pt 7, 522-5 (July, 1959).

The structure of danburite, $CaB_2Si_2O_8$, which was solved by Dunbar and Machatschki (1930), has been refined by the method of least squares. The boron atom is found to be in the centre of a BO_4-tetrahedron with no significant differences between the four boron–oxygen distances. The average value of the cation–oxygen distances within the BO_4-tetrahedra is 1.47 ± 0.02 A and within the SiO_4-tetrahedra 1.62 ± 0.01 A.

548.736.6

9045. EFFECT OF THERMAL MOTION ON THE X-RAY REFLECTIVITY OF QUARTZ. D.W.Berreman and TeTse Chang.

J. Appl. Phys., Vol. 30, No. 7, 963-6 (July, 1959).

Two characteristic temperatures for quartz were determined which, when substituted into the Debye-Waller formula and then used to compute the ratios of temperature corrected integrated reflection coefficients of various pairs of sets of Bragg planes, gave results in best agreement with experimentally determined ratios. These temperatures are 508 ± 16°K in the direction of the trigonal axis and 452 ± 15°K in any perpendicular direction. Corresponding values obtained from an approximate formula relating characteristic temperatures with elastic constants were 448° and 398°K, respectively. The fairly good agreement between the characteristic temperatures obtained by the two methods seems to support the conjecture that the modification of the Debye theory used gives a fairly good approximate description of the effect of thermal motion on the X-ray reflectivity of quartz. Calculations based upon the experimentally determined characteristic temperatures indicate that when Bragg spacings are less than about 0.7 A, the reflectivity of quartz at room temperature is reduced to less than half the value that would be obtained if the atoms were rigidly fixed.

548.737

046. A CUBIC FORM OF OX HAEMOGLOBIN. A.C.T.North.
cta cryst, Vol. 12, Pt 7, 512-14 (July, 1959).

The crystals of a new form of ox oxy-haemoglobin are cubic, of pace group $P4_132$ or $P4_332$. The unit cell, of edge 142.2 A, contains 2 haemoglobin molecules.

548.737 : 539.19

THREE DIMENSIONAL STRUCTURE OF GLOBULAR ROTEINS. See Abstr. 8777

548.737

047. CRYSTALLOGRAPHIC DATA FOR BENZENEARSONIC CID. J.H.Bryden.
cta cryst., Vol. 12, Pt 7, 558 (July, 1959).

548.737

048. THE PHASE TRANSFORMATION OF SOLID NORMAL EXADECANAMIDE. T.Sakurai and M.Yabe.
. Phys. Soc. Japan, Vol. 13, No. 1, 5-15 (Jan., 1958).

A phase transformation of normal hexadecanamide $C_{15}H_{31}CONH_2$) in which the crossed hydrocarbon chain configuration hanges into the parallel-chain one is investigated by means of X-rays, hermal analysis, infrared absorption and proton magnetic resonance bsorption. Based upon the knowledge of the crystal structure and -ray observation, a mechanism of successive reorientation of the ydrocarbon chain at this transformation is proposed. The twisting ibration of the hydrocarbon chain is found to play an important role or this transformation.

548.74

049. ELECTRON DIFFRACTION AND IMAGING EFFECTS FOR UPERIMPOSED THIN CRYSTALS. J.M.Cowley and A.F.Moodie.
cta cryst., Vol. 12, Pt 6, 423-8 (June, 1959).

The possibility is explored of obtaining structural information rom the moiré-like patterns observed in electron micrographs of verlapping thin crystals. General expressions are derived for he amplitude distribution in any plane of observation following two hin crystals. It is shown that in certain special cases this amplitude distribution approximates to the convolution of the projections of the potential distributions of the two crystals. Structural information may be derived from such a convolution function. Methods are indicated for determining how the resolution obtainable depends on the thickness of the crystals, their separation and mutual orientation.

548.74

9050. FURTHER ELECTRON OPTICAL OBSERVATIONS ON CRYSTALS OF ANTIGORITE. J.A.Chapman and J.Zussman.
Acta cryst., Vol. 12, Pt 7, 550-2 (July, 1959).

For previous work see Acta cryst., Vol. 11, Pt 2, 99-102 (Feb., 1958). Fringe systems with appropriate spacings were observed in electron micrographs of crystals of antigorite varieties which have cell parameters A ≅ 40 A and A ≅ 19 A. Contiguous regions of a single crystal of a fibrous antigorite showed spacings of 19.1 and 16.8 A respectively. Possible relationships between the variable spacings and crystal structure are discussed.

548.74

9051. VARIATION IN LATTICE CONSTANT IN THIN FILMS OF GOLD. S.N.Chatterjee.
Indian J. Phys., Vol. 31, No. 2, 110-16 (Feb., 1957).

Lattice constants of gold for films of different thicknesses (3-120 A) were determined by the electron diffraction technique. It was found that for thin films of gold 1-10 A thick the lattice constant increases by about 5% over the value of the constant for films 40-120 A thick.

548.74 : 538.2

ELECTRON DIFFRACTION STUDY OF STAINLESS STEEL. See Abstr. 8288

548.74

9052. A SIMPLE METHOD FOR THE DETERMINATION OF CRYSTAL LATTICE CONSTANTS BY ELECTRON DIFFRACTION PATTERNS FROM THE SURFACE OF AN OBJECT.
N.A.Shishakov.
Kristallografiya, Vol. 2, No. 5, 690 (1957). In Russian. English translation in: Soviet Physics — Crystallography (New York), Vol. 2, No. 5, 679-80 (Sept.-Oct., 1957).

GEOPHYSICS

550.342

053. SEISMIC SCALING LAW FOR UNDERGROUND XPLOSIONS. A.L.Latter, E.A.Martinelli and E.Teller.
hys. of Fluids, Vol. 2, No. 3, 280-2 (May-June, 1959).

Observations indicate that the amplitudes of distance seismic ignals from underground nuclear explosions are approximately roportional to the total energy release. It is shown that these bservations can be accounted for by a simple model which assumes hat the nonlinear region close to the explosion is similar for all xplosions and that the linear region transmits only low-frequency aves.

550.382

054. MAGNETIC ANISOTROPY IN DEFORMED ROCKS, AND HE ORIGIN OF THEIR NATURAL REMANENCE. L.Daly.
.R. Acad. Sci. (Paris), Vol. 248, No. 18, 2614-16 (May 4, 1959).
French.

The natural remanence of the rock specimens investigated has n origin different from those giving rise to the isothermal remanent nd thermoremanent magnetizations, which exhibit a strong magnetic nisotropy.
E.P.Wohlfarth

550.385

055. SUDDEN COMMENCEMENTS AND IMPULSES IN ODAIKANAL MAGNETOGRAMS — THEIR HOURLY FREQUENCY.
.Srinivasamurthy.
dian J. Meteorol. Geophys., Vol. 10, No. 2, 209-12 (April, 1959).

The diurnal variation in the frequencies of sudden commence-ents (SCs) and sudden impulses (SIs) is analysed from the data for e period 1949-57. The hourly frequency curve of SCs and SIs ombined) has little resemblance to the curve obtained from ewton's analysis of Greenwich—Abinger records. The results of harmonic analysis show a nearly semi-diurnal trend in the distribution of storm sudden commencements (SSCs); this, however, is small. The hourly frequencies of SIs show a significant diurnal variation with an afternoon maximum and a forenoon minimum and a secondary minimum around 18 h local time and a secondary maximum around 08 h. These results are also compared with those obtained by Ferraro Parkinson and Unthank.

550.385

9056. ON THE ANNUAL VARIATION OF MAGNETIC DISTURBANCE. D.H.McIntosh.
Phil. Trans A, Vol. 251, No. 1001, 525-52 (1959).

Statistical features of the annual incidence of magnetic disturbance, over a very wide range of disturbance intensity and latitude, are exhaustively investigated by means of the K index and related "planetary" indices. Two distinct and physically significant components are identified: (a) an annual component, with summer maximum and winter minimum; (b) a semi-annual component with equinoxial maxima. Both components are found in all parts of the earth. The amplitude of the annual component increases markedly with latitude, while that of the semi-annual component changes little with latitude. The physical causes of the two types of variation are finally considered. The conclusions reached are (a) that the annual component is probably caused by an atmospheric dynamo effect; (b) that the semi-annual component arises because of a systematic annual variation of the angle between the earth's magnetic axis and the sun-earth line, along which travel the solar particles which cause magnetic disturbance.

550.386

9057. ON CERTAIN STATISTICAL EFFECTS IN THE PROBLEM OF THE ORIGIN OF GEOMAGNETIC DISTURBANCES.
E.R.Mustel and O.N.Mitropolskaya.

Observatory, Vol. 79, 15-18 (Feb., 1959).

The results of Allen's statistical treatment of recurrent M-disturbances are interpreted assuming that the principal source of such disturbances are plages. It is suggested that plages are sources of approximately radial corpuscular streams, and recent results are used to check this hypothesis. S.J.St-Lorant

550.385 : 523.164.32

9058. THE RELATIONS BETWEEN SOLAR RADIO ACTIVITY AND SUDDEN COMMENCEMENT MAGNETIC STORMS.
I.Özdoğan.
Rev. Fac. Sci. Univ. Istanbul C, Vol. 23, No. 2, 155-68 (April, 1958). In French.

The relations between solar phenomena and terrestrial magnetic activity is reviewed. A study has been made of the correlation between radiofrequency activity of sunspots and sudden commencement magnetic storms. It is concluded that there is no direct relationship. There is also no apparent correlation between chromospheric eruptions and magnetic sudden commencements. H.J.A.Chivers

550.9 : 539.1.07

REDUNDANT COUNTING CIRCUITRY FOR USE IN CARBON-14 DATING. See Abstr. 8427

551.463

9059. SOME PHYSICAL PROPERTIES OF SEA ICE. I.
E.R.Pounder and E.M.Little.
Canad. J. Phys., Vol. 37, No. 4, 443-73 (April, 1959).

This preliminary study is based mostly on work done at a shore station in Shippegan, N.B., during the winter of 1956-7, with some data from an ice-breaker expedition in the summer of 1956. The Shippegan site had unrafted ice, tides of 5 feet or less, and negligible fresh-water runoff. The thickness of the ice was about proportional to the square root of the freezing exposure. Tritium dating of sea ice is an unsatisfactory method because of variable tritium concentration in Arctic waters. The jaggedness of ice crystals is suggested as a measure combing effects of age and thermal regime. Measurements of specific gravity, salinity, electrical resistivity, and permeability profiles all show progressive changes in annual sea ice throughout the winter. The tensile strength of sea ice at −20°C was around 200 to 500 p.s.i., at various angles to the grain. For fresh-water ice, with stress parallel to the grain, it was in the range 500 to 1000 p.s.i. Shear strengths, with the shear plane parallel to the grain, were 80 to 160 p.s.i. for sea ice at −20°C and 160 to 280 p.s.i. for pond ice, also at −20°C.

551.481.18 : 534.24

9060. ACOUSTIC CHARACTERISTICS OF A FLORIDA LAKE BOTTOM. R.J.Bobber.
J. Acoust. Soc. Amer., Vol. 31, No. 2, 250-1 (Feb., 1959).

Corroboration of results published by Jones et al. (Abstr. 9183 of 1958). H.D.Parbrook

ATMOSPHERE . IONOSPHERE

551.508.21

9061. A CONTRIBUTION TO ABSOLUTE PYRHELIOMETRY.
A.J.Drummond.
Quart. J. Roy. Meteorol. Soc., Vol. 82, 481-93 (Oct., 1956).

The results are presented of comparisons made in Southern Africa, during the years 1951-1954, between pyrheliometers of the Angström type which had been standardized at Davos (Switzerland), Leopoldville (Belgian Congo), Pretoria (South Africa) and Stockholm (Sweden). Results are also given of an investigation into the relationship between the original Angström scale and that embodied in the Abbot pattern of actinometer of the Smithsonian Institution, Washington. This latter series of comparisons was made at Pretoria (altitude 1370 m), under normal conditions of cloudless sky with reasonably steady atmospheric transmission. The programme was extended to include a comparison between specimens of these two sub-standard radiometers using a controlled laboratory source of radiation. In these conditions, the radiometers were found to agree to within $\frac{1}{3}$%. This is further evidence of the small divergence (first pointed out by Guild in 1937) of the scale originated long ago by K.Angström, from the true standard of radiometry.

551.508.71 : 533.275

RECORDING MICROWAVE HYGROMETER. See Abstr. 7850

551.51 : 534.222

FOCUSING OF SOUND ENERGY IN THE AIR DUE TO WIND EFFECTS. See Abstr. 7884

551.510.3

9062. DENSITY OF THE ATMOSPHERE AT HEIGHTS BETWEEN 200 km AND 400 km, FROM ANALYSIS OF ARTIFICIAL SATELLITE ORBITS. D.G.King-Hele.
Nature (London), Vol. 183, 1224-7 (May 2, 1959).

If the mass and dimensions of a satellite are known, observations of the rate of decrease of its period of revolution (mainly determined by the effect of atmospheric drag in the region near perigee, provided the eccentricity of the orbit > 0.02) allow values of the air density at heights near perigee to be determined. Results are given for ten satellites and the surprisingly consistent values obtained place some confidence in the assumptions made. There is no indication of a significant variation of air density between latitudes 50°N and 35°S, in contrast with rocket results. Derivation of scale heights, and hence atmospheric temperatures, from the mean results are subject to considerably greater uncertainty than are the density determinations. G.M.Brown

551.510.3

9063. AN EXPERIMENTAL AND INDIRECT METHOD FOR DETERMINING THE HIGH ATMOSPHERE'S DENSITY.
C.Casci and V.Giavotto.
Nuovo Cimento, Vol. 11, No. 2, 291-7 (Jan. 16, 1959).

Approximate values of the density of the atmosphere up to 450 k have been calculated from data available for the observed lifetime o artificial satellites. An exponential decrease of density with height is assumed, and the constants involved in the numerical integration have been determined from direct rocket measurement and satellite 1957α data. G.M.Brow

551.510.4

9064. RATIO OF HT/HTO IN THE ATMOSPHERE. F.S.Rowland.
J. chem. Phys., Vol. 30, No. 4, 1098-9 (April, 1959).

Nuclear and chemical reactions which might produce the HT and HTO found in the atmosphere are discussed. G.I.W.Llewely

551.510.53

9065. A POSSIBLE WAY OF MEASURING THE CONCENTRATIO OF SLOW NEUTRONS IN THE F2 LAYER OF THE IONOSPHERE.
V.N.Kessenikh.
Dokl. Akad. Nauk SSSR, Vol. 123, No. 1, 57-9 (1958). In Russian.

It is suggested that the neutrons produce electrons and that the effect of the resulting ionization will show up in the critical frequenc for the ionosphere. J.M.Houg

551.510.535 : 550.385

9066. IONOSPHERIC DISTURBANCES ASSOCIATED WITH MAGNETIC STORMS AT KODAIKANAL.
B.N.Bhargava and U.V.Gopala Rao.
Indian J. Meteorol. Geophys., Vol. 10, No. 2, 203-8 (April, 1959).

F2-layer disturbances have been analysed in order to study the behaviour of the critical frequency and the virtual height. The disturbances are classified for this purpose into two categories: the positive and negative. The characteristics of D_{st} and S_D variation of f_0F2, and the S_D variation of h'F at night, are discussed. The results are explained in terms of the quiet and disturbed day vertica drift velocities.

551.510.535

9067. ON THE EXISTENCE OF A STRONG MAGNETO-IONIC EFFECT TOPSIDE OF THE F MAXIMUM OF THE KENELLY-HEAVISIDE LAYER. P.R.Arendt.
J. appl. Phys., Vol. 30, No. 5, 793-5 (May, 1959).

Anomalous signal fading during some very high altitude passage of the satellite Explorer IV has been observed. It is concluded that significant magneto-ionic effects take place up to altitudes of at least 2000 km. H.J.A.Chivers

551.510.535

9068. A NEW THEORY OF FORMATION OF THE F2 LAYER.
T.Yonezawa.
J. Radio Res. Lab. (Tokyo), Vol. 3, 1-16 (Jan., 1956).

Assumptions are made as follows: In the lower portion of the

F2 layer it is assumed that the height distribution of electron density is determined by electron removal due to dissociative recombination with molecular oxygen ions generated by the atom—ion interchange reaction between atomic ions and neutral molecules of oxygen. In the upper part of the layer the distribution is assumed to be determined by electron—ion diffusion in the earth's gravitational field, the maximum density being produced at an intermediate height by both processes. Calculations of the steady-state distribution of electron density, based on the above assumptions, give a reasonable form thinner than the conventional Chapman layer and with its maximum density around 300 km. The theoretical variations of the maximum density and of its height with change of geomagnetic latitude agree fairly well with observations except near the equator.

A.Wilkinson

551.510.535

9069. A NEW THEORY OF FORMATION OF THE F2 LAYER. II. THE EFFECT OF THE VERTICAL MOVEMENT OF ELECTRONS AND IONS ON THE ELECTRON DENSITY DISTRIBUTION.

T.Yonezawa.

J. Radio Res. Lab. (Tokyo), Vol. 4, 1-14 (Jan., 1957).

For Pt I see preceding abstract. The vertical velocity of the movement was assumed to increase exponentially with height in inverse proportion to the atmospheric molecular density. Both the maximum electron concentration and the height of its level increase for upward electron-ion movements and the reverse is true for downward ones, and in the former case stratification cannot be attained for velocities exceeding certain limits which are dependent on the magnetic dip. The lower portion of the electron density distribution, however, is hardly influenced by the movement. If the variation is assumed of vertical electron-ion movement with latitude which is somewhat similar in form to that deduced theoretically by Martyn or Maeda except near the geomagnetic equator, a more satisfactory agreement between theory and observation is arrived at than in the previous paper in the case of the latitudinal distribution of the maximum electron concentration, but the magnitude of velocity needed seems to be too large in higher latitudes where it amounts to as high as 50 km/hr. In the case of the latitudinal distribution of the height of maximum ionization, on the contrary, fairly close agreement between theory and observation can be achieved without invoking the electron-ion movement and consideration of its effect seems to make the situation rather worse.

551.510.535

9070. A NEW IONOSPHERIC PHENOMENA.

H.J.A.Chivers and H.W.Wells.

Nature (London), Vol. 183, 1178 (April 25, 1959).

The observation of an enhancement and a reduction of radio-frequency energy simultaneously, from different sectors of the sky, is reported. This effect could be caused by the passage of high energy corpuscular streams through successive ionospheric layers.

H.J.A.Chivers

551.510.535

9071. OBSERVATIONS OF INTENSE IONIZATION OF LONG DURATION BELOW 50 km ALTITUDE AFTER SOME STRONG SOLAR FLARES. B.Hulqvist and J.Ortner.

Nature (London), Vol. 183, 1179-80 (April 25, 1959).

Absorption of extra-terrestrial radio waves decreases at night as photodetachment processes cease to contribute to the electron density. After some days of intense absorption conditions, the change to night conditions was complete when the 50 km level was no longer illuminated. The authors suggest that this implies the presence of intense ionization below 50 km altitude on those days.

H.J.A.Chivers

551.510.535

9072. ROCKET OBSERVATIONS OF THE IONOSPHERE.

H.Friedman.

Proc. Inst. Radio Engrs, Vol. 47, No. 2, 272-80 (Feb., 1959).

Daytime electron density profiles measured at Fort Churchill were found to be similar to those observed at White Sands. One winter night-time flight showed very little ionization, less than 20 000 electrons per cm^3 up to 165 km. Polar blackout produced strong enhancement of the D-region electron density down to 55 km. NO$^+$ is the predominant ion below 200 km during the night, but O$^+$ becomes the most abundant ion above 150 km during the day. Solar flares are accompanied by X-ray bursts capable of penetrating to the 60 km level and sufficiently intense to account for sudden ionospheric disturbances. At night a diffuse glow of Lyman-α is visible over the entire sky. From the observed intensity it is possible to estimate the electron density of interplanetary space.

551.510.535

9073. DRIFT MEASUREMENTS OF THE E-LAYER.

L.Harang and K.Pedersen.

Geofys. Publ., Vol. 19, No. 10, 30 pp. (1956).

Detailed account of spaced-receiver measurements made at Oslo on 2 Mc/s over the period June 1953 to September 1955, and comparison with the results of other workers. There is a prevailing drift towards the S.W. in winter, and towards N.E. in summer, together with a semi-diurnal wave at all seasons. During daytime, there appears to be no systematic change in wind direction on days when reflections are obtained from the normal E or from the E_s layers, but after sunset there is a sudden change in the direction of the E—W component when E_s reflections are used. A similar change occurred in measurements made during the solar eclipse of 30 June 1954 (99% total at Oslo) when the reflection changed from E to E_s.

G.M.Brown

551.510.535

9074. THE WORLDWIDE DISTRIBUTION OF THE F2 LAYER ELECTRON DENSITY: SEASONAL AND NON-SEASONAL VARIATIONS AND CORRELATIONS WITH SOLAR ACTIVITY.

F.Mariani.

Nuovo Cimento, Vol. 12, No. 3, 218-40 (May 1, 1959).

The worldwide behaviour of the twelve-month period (seasonal and non-seasonal) variation of the maximum electron density N in the F2 layer appears noticeably different at noon and at midnight. In each case, it is controlled by the geomagnetic field and by the solar activity but, whilst at noon it shows large asymmetric features in the two hemispheres, at midnight, on the other hand, it is fairly symmetrical. It is not possible to account for the experimental results by assuming some external source of radiation producing non-seasonal effects. One is led to assume some terrestrial cause of asymmetry; for example, some effect of general circulation in the upper atmosphere. With respect to the correlation of electron density with solar activity, there appears again some noticeable asymmetry in the two hemispheres; in particular, the northern hemisphere appears more influenced by the solar hydrogen filaments, especially for increasing latitude. The explanation of these asymmetries, in terms of some direct influence of the sun, is also puzzling, so that, in this case, one is led to think of some more or less unknown effect of solar corpuscular (or electromagnetic) radiation on the upper atmosphere, for example, on its movements or its conductivity. At the present state of knowledge, one cannot exclude the possibility of a similar cause for both the asymmetries of the twelve-month period variation and of the correlations with solar activity. Further observational evidence is required.

551.510.535 : 539.12

9075. COLLISION FREQUENCY OF ELECTRONS IN THE TERRESTRIAL ATMOSPHERE. M.Nicolet.

Phys. of Fluids, Vol. 2, No. 2, 95-9 (March-April, 1959).

An analysis of the collision frequency of electrons in the terrestrial atmosphere was made using recent experimental and observational data. Application to collisions of electrons with neutral particles and positive ions shows that the electronic collision frequency is due to neutral particles below the peak of the F_1 layer and results from positive ions in the F_2 layer.

551.510.535

9076. AN INVESTIGATION OF IONOSPHERIC INHOMOGENEITIES BY RADIOASTRONOMICAL METHODS. V.V.Vitkevich.

Radiotekhnika i Elektronika, Vol. 3, No. 4, 478-86 (1958).

In Russian.

Electronic non-uniformities in the ionosphere are studied by interferometric observations, at meter and decimetre wavelengths, of the sun and especially of radio stars. Experimental details are given. The dimensions (significantly greater than the wavelength) and electron concentration of large scale inhomogeneities are calculated from the irregular vertical ionospheric refraction. The refractive index along the path of propagation of the radiowaves changes slowly and differs little from 1. Irregular horizontal refraction in the ionosphere was observed at 6 m and corresponding breaks in the interference pattern noted. Assuming that the inhomogeneities responsible exist at a height of 300 km, their dimensions are of the order of 5-10 km and they move at about $\frac{1}{2}$-1 km/sec.

G.A.Chisnall

551.510.535

9077. THE PROBLEM OF DETERMINING THE ELECTRON DENSITY IN THE IONOSPHERE. Ya.I.Khanin.
Radiotekhnika i Elektronika, Vol. 3, No. 11, 1399-402 (Nov., 1958).
In Russian.

An expression for the fluctuations in electron density in the ionosphere is derived theoretically taking into account the variation of wavelength in the ionosphere with height, using a method suggested by Alpert (Abstr. 4579 of 1958). R.C.Glass

551.510.535

9078. ON A POSSIBLE EXPLANATION OF THE IONOSPHERIC LAYERS. T.V.Ionescu.
Rev. de Physique (Bucarest), Vol. 11, No. 2, 165-73 (1957).
In French.

A theory is developed on the assumption that in the lower ionosphere nearly all the electrons are attached to O_2 molecules. The characteristic absorption frequencies of O_2^- ions are near the frequency of probing e.m. waves. The variation of the maximum concentration of negative ions with temperature is computed, and for the smaller critical frequencies encountered in the ionosphere the maximum concentration corresponds to the temperature 189°K, which is near that determined for the 100 km level from rocket flights and from airglow studies. The upper ionized layer is considered to consist of negative ions and free electrons.
G.M.Brown

551.510.535 : 537.533 : 539.18

CHARGE TRANSFER REACTIONS IN THE UPPER ATMOSPHERE. See Abstr. 8692

551.510.535

RADIO-WAVE PROPAGATION IN THE IONOSPHERE. See also the Section entitled "ELECTROMAGNETIC WAVES AND OSCILLATIONS".

551.521.1 : 551.510.535

9079. INVESTIGATION OF DISCRETE SOURCES OF RADIATION FROM SOLAR ECLIPSE OBSERVATIONS. N.Mitra.
Indian J. Phys., Vol. 31, No. 2, 69-82 (Feb., 1957).

Ionospheric observations during the partial solar eclipse (89.5%) of 20th July, 1944 have been critically examined in order to determine whether the reduction of ion-density of the E layer with the progress of the eclipse follows Chapman's theory of layer-formation based on a homogeneous distribution of radiation across the solar disc. The observed time-difference of 10 minutes between the maximum of the eclipse and the minimum of the ion-density gives the value of effective recombination coefficient as $\alpha = 0.56 \times$ $\times 10^{-8}$ by employing Appleton's "sluggishness" formula. α is also calculated from the variation of N_e around local noon during the control period, which gives α as 0.55×10^{-8}. The variation of the observed and computed values of J, the ion-production function, indicates that there must have been some discrete sources of radiation on the east limb of the sun causing the asymmetry in the variation of N_e with the progress of the eclipse. Various models of the sun are then assumed from known variations of the obscuration functions of the disc and limb and the values of J calculated for different values of contributions from the east and west limbs of the sun. By a series of trials, a suitable model is worked out which fits well with the observed variation of J. This model, when compared with the sun-chart of the eclipse day, is found to be a representative one. There were some prominences of the east limb which were possible causing extra ionization of the E layer before the maximum of the eclipse. This indicates that, in addition to a homogeneous distribution of radiation across the solar disc, discrete sources on the limb play an important part in causing the ionization of the E layer.

551.521.3

9080. EXPERIMENTAL STUDY OF THE EFFECT OF FIELD OF VIEW ON TRANSMISSION MEASUREMENTS. M.G.Gibbons.
J. Opt. Soc. Amer., Vol. 49, No. 7, 702-9 (July, 1959).

The ratio of the amounts of scattered and direct radiation received from a 4π source has been measured in the San Francisco Bay area for source—receiver distances of 1.18, 4.33, 6.79, 9.81, and 14.37 miles. A large flashlamp surrounded by a frosted globe was used as the source. The receiver consisted of any one of five combinations of Wratten filters and photomultiplier tubes having peak responses at 0.40, 0.50, 0.70, 0.83, and 0.90 μ and feeding into an oscilloscope, the screen of which was photographed. A device for controlling the field of view of the receiver allowed choice of fields of view from 4 to 58.33 degrees half-angle, and an occulter allowed the direct radiation to be blocked out if desired. It has be found that for a given field of view the ratio of scattered to direct radiation received from such a source under no overcast condition is greater the shorter the wavelength and that for source—receive distances of up to about 7 miles this ratio is approximately proportional to the optical thickness (path length times attenuation coefficient) of the path. For the source—receiver distances greate than 7 miles and a given attenuation coefficient and field of view, th ratio in question has been found to decrease slowly with increasing distance.

551.521.3

9081. SPECTRA OF THE NIGHT SKY IN THE REGION 8200-11200 Å. N.I.Fedorova.
Dokl. Akad. Nauk SSSR, Vol. 125, No. 3, 535-7 (March 21, 1959).
In Russian.

A series of measurements of frequencies and intensities of the OH bands in the radiation of the night sky was made over a period of several months, and used to determine the rotational temperatur of these bands. For the mean rotational temperature, the value 236 ± 15°K is given. E.K.Gora

551.521.32

9082. NEW BANDS AND LINES IN THE TWILIGHT SKY SPECTRUM. I.A.Khvostikov and T.G.Megrelishvili.
Nature (London), Vol. 183, 811 (March 21, 1959).

Twenty-seven features of the twilight spectrum over the wavelength range 5400-6800 A from 29 morning and 38 evening spectrograms. In addition to the common O I and Na I lines, identifications with lines of A, Ca, Li, Ne and bands of N_2, OH, CO, C_2, H_2, H_2O are made. R.W.Nicholl

551.521.32

9083. OBSERVATIONS OF THE LITHIUM LINES IN THE TWILIGHT AIRGLOW IN THE NORTHERN HEMISPHERE.
A.V.Jones.
Nature (London), Vol. 183, 1315-16 (May 9, 1959).

Recent observations made at Saskatoon, Canada, indicate abundance values of $\sim 9 \times 10^6$ atoms/cm^2, and $\sim 20 \times 10^9$ atoms/cm for Li, and Na respectively. These give an abundance ratio of ~ 45 $\times 10^{-5}$ as compared with $\sim 2 \times 10^{-3}$ for meteors, and $\sim 2 \times 10^{-5}$ fo sea-water. Because of the uncertainty of measurement, the above result is indecisive as an indication of the actual source of the two atomic constituents in the upper atmosphere. D.R.Barbe

551.521.6

9084. PRESENCE OF THE 3303 A LINE IN THE EMISSION SPECTRUM FROM ARTIFICIAL SODIUM CLOUDS.
A.Vassy and É.Vassy.
C.R. Acad. Sci. (Paris), Vol. 248, No. 15, 235-6 (April 13, 1959).
In French.

Following the ejection of Na from high-altitude rockets fired at 20 min. after sunset, and 25 min. before sunrise on 10, and 12 Marc 1959 respectively, spectrograms of the resulting luminescence were obtained on each occasion at a station 120 km from the launching site. The dusk exposure showed no trace of the (4P-3S) doublet at 3303 A, whereas the blended lines are undoubtedly present in the spectrogram taken at dawn. The yellow doublet (at 5893 A) is prominent in both spectra. The observation that the ultraviolet lines appear to be more easily excited at dawn can explain previous failures to detect these lines in the twilight airglow. D.R.Barber

551.521.6

9085. THE VELOCITY DISPERSION OF A SOLAR CORPUSCULA STREAM NEAR THE EARTH. B.A.Bagariatskii.
Astron. Zh., Vol. 35, No. 2, 227-9 (1958). In Russian. English translation in: Soviet Astron — AJ (New York), Vol. 2, No. 2, 203-5 (March-April, 1958).

The velocity dispersion of a corpuscular stream on reaching the earth is calculated. It is shown that this is insufficient to explain the observed form of the contour of hydrogen lines in aurorae.

551.525.

9086. A PORTABLE INSTRUMENT [USING THERMOCOUPLES] FOR DETERMINING SOIL TEMPERATURES AT VARIOUS DEPTHS
M.Salaruddin.

Indian J. Meteorol. Geophys., Vol. 19, No. 2, 199-202 (April, 1959).
The instrument, as constructed, can record temperatures at depths of 5, 10, 15 and 30 cm and also at depths of 10, 15, 20 and 35 or 15, 20, 25 and 40 cm by inserting it into the soil to different points. The instrument can be installed by simply driving it into the soil without materially disturbing the soil packing or the vegetation cover and reliable readings can be obtained within a short time of its insertion — unlike ordinary soil thermometers.

551.593.5

9087. TEMPERATURE DEPENDENCE OF THE RAYLEIGH SCATTERING COEFFICIENT IN THE ATMOSPHERE.

D.Deirmendjian.
J. Opt. Soc. Amer., Vol. 48, No. 12, 1018-19 (Dec., 1958).
Referring to a paper by Penndorf (Abstr. 2871 of 1957) it is pointed out that the Rayleigh scattering coefficient is determined mainly by the density of the air and that "temperature per se has only a minor effect". G.F.Lothian

551.593.55

9088. NITROGEN OXIDES AND THE AIRGLOW. M.Nicolet.

Contrib. Inst. Roy. Meteorol. Belgique, No. 39 (1958) = Threshold of space. London: Pergamon Press (1958) pp. 40-59.
Theoretical considerations connected with the problem of oxides of N in the upper atmosphere are discussed. In particular, the computed NO concentration in the ionosphere, $5\text{-}1 \times 10^{8}$ cm^{-3} around 80 km, can provide an interpretation of photo-ionization effects in the D-layer associated with quiet, and disturbed sun. Also, it appears possible that both NO, and NO$_2$ may contribute to the maintenance of the diffuse airglow spectrum in the Vegard–Kaplan and visual regions. As yet, no observational evidence of either of these molecules in the upper atmosphere is available. D.R.Barber

551.594.13

9089. SPACE AND TIME VARIATIONS OF CHARGED NUCLEI AND ELECTRICAL CONDUCTIVITY OF THE ATMOSPHERE.

R.C.Sagalyn and G.A.Faucher.
Quart. J. Roy. Meteorol. Soc., Vol. 82, 428-45 (Oct., 1958).
The time variations of electrical conductivity and charged ucleus concentration were investigated in fair weather in the ltitude range 700 to 15000 ft above the surface. In the exchange ayer regular variations of nucleus concentration with time are bserved from around sunrise to early afternoon. Analysis of the meteorological data obtained simultaneously shows that this variation is due primarily to the daily turbulent cycle. During periods f low advection, regular variations of nucleus concentration with time from early afternoon to the following sunrise are also observed n this region, and are shown to be the result of nucleus coagulation nd subsidence. The time variations at night are more complicated uring periods of intense advection. Above the exchange layer ariations in nucleus content with time are not found to be regular. The variations in electrical conductivity with time are the inverse f the changes in nucleus concentration. The observed relation etween conductivity and nucleus concentration is in good agreement ith the theory of small ion balance, using Thomson's theory for mall ion volume recombination and Bricard's theory for collisions etween small ions and nuclei. An analysis of observed daily ariations in the magnitude of the horizontal fluctuations of these ariables is also given.

551.594.14

090. COBALT-60 FROM THERMONUCLEAR TESTS IN THE TMOSPHERE. L.Marquez, N.Leal da Costa and I.G.de Almeida.

n. Acad. Brasil Cienc., Vol. 30, No. 3, 307-10 (1958).
Rain water collected over nine months at Rio de Janeiro has een processed and Co$_3$O$_4$ precipitated. The gamma-ray spectrum ndicates the presence of Co^{60}. G.I.W.Llewelyn

551.594.14

091. DIURNAL AND OTHER FLUCTUATIONS IN ATMOSPHERIC ADIOACTIVITY OF NATURAL ORIGIN.

.C.Delwiche and P.R.Stout.
ull. Amer. Meteorol. Soc., Vol. 40, No. 6, 285-90 (June, 1959).
The radioactivity of the atmosphere resulting from natural ources has been monitored continuously for a period of two years. he method consists of collecting on moving strips of filter paper e daughter products of radon and thoron decay — principally Pb^{212} nd Pb^{214}. The highest activities found were 5×10^{-13} c/l of atmosphere and the lowest values in the order of 10^{-14} c/l. Changes in radioactivity may take place very rapidly so that a very high value may fall to one of the low values within an hour or less. Recent history of the air mass being sampled determines its content of these radioactive isotopes of natural origin. Maximal values are always characterized by still air held over land. Minimal values have been associated with air masses having been held over the sea where replenishment of radon is much reduced. The turbulence of winds causes mixing of radon with greater masses of air with correspondingly diluted levels of radioactivity. In spite of the high degree of variability in atmospheric radioactivity from day to day or even from hour to hour, averages of the mean hourly activities when taken over a year in Berkeley, California show a well defined diurnal fluctuation. In this respect, data for 1955 are very close to those for the year 1956. On the yearly average, maximum activity occurs at 6 a.m. and minimum acitivity at 6 p.m. The averaged radioactivity of the atmosphere in the morning is about 40 per cent greater than the activity in the evening. This difference is probably a reflection of the tendency for offshore winds to migrate inland during the afternoon hours. Samplings of stagnant air in wells and caves showed very high activity as compared to the open atmosphere. As much as 10^{-10} c/l of air have been observed in enclosed atmospheres.

551.594.14

9092. REDETERMINATION OF THE NATURAL TERRESTRIAL DECAY RATE OF TRITIUM AND THE PROBLEM OF THE ORIGIN OF NATURAL TRITIUM. F.Begemann.

Z. Naturforsch., Vol. 14a, No. 4, 334-42 (April, 1959). In German.
The tritium content of old snow samples from Greenland was studied. The findings of Craig and Begemann and Libby, that the tritium decay rate is about 10 times higher than was anticipated previously, was confirmed. Two mechanisms to explain the discrepancy are discussed, (a) production by the low energy component of cosmic radiation; (b) the accretion of solar tritium by the earth, as suggested by Field and Arnold. It is shown that in case all the tritium is produced by cosmic radiation the tropospheric production rate may be expected to vary in antiphase with the sunspot cycle, whereas in case of accretion of solar tritium by the earth the variation should be in phase with the sunspot cycle. In both cases a phase shift between the stratospheric production rate and the amount of tropospheric tritium is to be expected because of the residence time of tritium in the stratosphere. A measurement of the phase shift should allow the determination of this residence time. The data obtained on the Greenland samples appear to show such a variation of the production rate. The results can be explained best by assuming that all the tritium is produced by cosmic radiation. This result, however, is only preliminary. More systematic measurements are required to decide betwen the two possibilities.

551.594.221

9093. A NEW METHOD OF MEASURING RAPID MAGNETIC FIELD VARIATIONS FROM ATMOSPHERIC ELECTRIC DISCHARGES BY USING A LOOP SYSTEM ON THE EARTH'S SURFACE. O.Norinder and E.Knudsen.

Ark. Geofys., Vol. 2, Paper 23, 481-9 (1956).
A large loop buried horizontally just below the earth surface is used to record, with the aid of amplifiers and c.r.o.'s, the vertical component of the field variations produced by lightning discharges to earth at distances up to 100 km. The physical basis of the method is described and typical results are shown to agree with records obtained on frame aerials used in earlier investigations. A frequency distribution of superimposed h.f. oscillations shows a peak in the wavelength region of 11 km. The variation of the wave shape of the signal with increasing distance is illustrated. For distances exceeding 100 km, the radiation wave shapes recorded in the horizontal loops are compared with records obtained on open-wire aerials. Discharges originating in wintry snow squalls are examined. R.H.Golde

551.594.221

9094. VARIATION FORMS AND TIME SEQUENCE OF MULTIPLE LIGHTNING STROKES. H.Norinder and B.Vollmer.

Ark. Geofys., Vol. 2, Paper 25, 515-31 (1957).
Typical oscillographic records are reproduced of the magnetic field changes produced by multiple lightning flashes in frame aerials at one or, simultaneously, at two recording stations. A variety of wave shapes was obtained, with or without h.f. oscillations superimposed on unidirectional wave shapes. The variation of wave shape due to successive discharges is illustrated and

discussed. Frequency distribution curves are given of the time intervals between component strokes and their duration. The relative amplitudes are indicated of the field changes produced by the first six component strokes in multiple flashes. R.H.Golde

551.594.221

9095. PRE-DISCHARGES IN RELATION TO SUBSEQUENT LIGHTNING STROKES.
H.Norinder and E.Knudsen.
Ark. Geofys., Vol. 2, Paper 27, 551-71 (1957).

Three predominant types of pre-discharge are described as recorded simultaneously by vertical and horizontal frame aerials. Statistical distribution curves are derived of the time intervals between the various rapid field variations and the amplitudes are plotted as a function of distance, pre-discharges with and without subsequent main field changes (caused by return strokes) being considered. On an average, the maximum amplitudes of rapid pre-discharges amount to about 15% of the subsequent main field changes. R.H.Golde

551.594.221

9096. THE THEORY OF THE DISCHARGE OF STORM CLOUDS BY LIGHTNING STROKES.
J.Papet-Lépine.
Ark. Geofys., Vol. 3, Paper 5, 79-96 (1958). In French.

A detailed theoretical treatment of the problem, based on an electrical circuit model. Temporal variations of lightning current are studied and particular attention is given to radiation. J.D.Craggs

551.594.222

9097. ATMOSPHERIC ELECTRIC DISCHARGES FROM DISTANT SNOW SQUALLS AND OCCLUSION FRONTS.
H.Norinder and E.Knudsen.
Ark. Geofys., Vol. 2, Paper 26, 533-50 (1957).

Oscillographic direction-finding equipment is described designed to determine the centres of origin of atmospherics recorded during winter months in the absence of thunderstorms. A series of weather maps are reproduced indicating snow squalls as the sources of these atmospherics. The characteristic shapes and amplitudes of these atmospherics are examined and are compared with others caused by lightning discharges. The cause of electrical discharges in snow and ice clouds is discussed. R.H.Golde

551.594.5

9098. POLARIZATION OF RADAR ECHOES FROM AURORA.
A.Kavadas and D.G.Glass.
Canad. J. Phys., Vol. 37, No. 6, 690-7 (June, 1959).

Auroral radar echoes at very high frequency received at aerials sensitive to linearly polarized components in directions symmetrical to the plane of polarization of the vertically polarized transmitted wave and the ground plane indicate that the received wave, in addition to an unpolarized component, contains a linear component of polarization tilted in the general direction of the earth's magnetic field lines.

551.594.5

9099. ON THE RING CURRENT HYPOTHESIS.
N.Wax.
Chalmers Tekn. Hogsk. Handl., No. 171, 32 pp. (1956).

In a critical review of ring current theories of the aurora it is noted that there is no agreement on the basic mechanism of corpuscular flow from the sun to earth, nor on the motion of the particles in the earth's field. A survey of observational data suggests that there is no convincing experimental proof of the ring's existence. R.A.Newing

551.594.5

9100. THE SAMOAN ARTIFICIAL AURORA.
H.Elliot and J.J.Quenby.
Nature (London), Vol. 183, 810 (March 21, 1959).

Calculation of the conjugate magnetic point to the Johnston Islands made on the basis of the terrestrial surface magnetic field parameters (inclination) rather than the total field parameters (Abstr. 7606 of 1959) were used to confirm with good accuracy the observed position (Abstr. 3017 of 1959) of the aurora-like phenomena at Apia Samoa following a high altitude nuclear explosion above the Johnston Islands. R.W.Nicholls

551.594.51

9101. COMPOSITION, VARIATIONS AND EXCITATION OF THE AURORAL LUMINESCENCE SPECTRA.
L.Vegard.
Geofys. Publ., Vol. 19, No. 9, 51 pp. (1956).

Detailed description of results obtained at Tromso over the winters of 1951-52 and 1952-53, using two large glass-spectrographs. Wavelength measurements of lines and bands and their identifications are fully tabulated, and these largely confirm previous results. Doppler shifts of the $H\beta$ and $H\gamma$ lines indicate proton velocities of the order of several thousand km/sec. Determinations of ionospheric temperatures give a mean value of 218.7°K for 10 bands observed in the one spectrograph, and a temperature ~ 220°K for 23 bands observed in the other spectrograph, corroborating the absence of temperature increase with altitude previously found. Auroral variability effects associated with latitude, altitude, auroral type, and the composition of the solar corpuscular streams are considered, with particular reference to the proton content of the streams. These solar ray "bundles" are believed to consist of electrons and positive ions (mainly protons), a predominant influence as far as the excitation of auroral luminescence is concerned being exerted by the electron rays. G.M.Brown

551.594.51 : 539.19

9102. EMISSION OF THE SPECTRUM OF NITROGEN IN HIGH LATITUDE AURORAE.
L.Herman, J.Morel and R.Herman.
Ann. Geophys., Vol. 12, No. 3, 228-31 (1956). In French.

Laboratory studies of the relative importance of the de-excitation of the metastable state $N_2(A)$ by collisions with electrons and with normal $N_2(X)$ molecules are considered with reference to auroral spectra. Conclusions are not possible until more exact values of the coefficients of excitation by electron collisions of the C, B, and A states of the N_2 molecule are available. G.M.Brown

551.594.51

9103. EXCITATION OF THE SPECTRUM OF THE SUNLIT AURORA.
P.K.Sen Gupta.
Indian J. Phys., Vol. 31, No. 7, 376-83 (July, 1957).

In the sunlit aurora certain features in its selective emission spectrum are known to be more intense as compared with the ordinary aurorae. The following mechanisms of the enhancement of these features in the selective emission spectrum of the sunlit aurora are discussed: (i) Photoionization of atmospheric constituents by solar ultraviolet radiation followed by the action of the solar corpuscular stream and secondary reactions. (ii) Ionization of atmospheric constituents by the solar corpuscular stream followed by resonance excitation by sunlight and secondary reactions. As the particle density in the upper atmosphere at the high altitudes concerned is extremely small, neither process can adequately account for the intensities observed. This difficulty disappears, if one considers that there is an increase in concentration of secondary ions and recombined atoms in columns in the vicinity of the earth's magnetic lines of force. Of the two mechanisms the first one is considered more likely.

551.594.52

9104. THE AURORAL DISPLAY OF 1958 SEPTEMBER 4-5.
B.McInnes and K.A.Robertson.
J. Brit. Astron. Soc., Vol. 69, No. 4, 167-76 (May, 1959).

Presents a brief analysis of the visual observations made in U.K. Some instrumental observations are briefly noted, and some aspects of the controlling effect of the geomagnetic field on auroral forms are described.

BIOPHYSICS PHYSIOLOGICAL PHYSICS

575.17

9105. GENETICS AND THE ROLE OF NUCLEIC ACIDS. C.Levinthal.
Rev. mod. Phys., Vol. 31, No. 1, 227-32 (Jan., 1959).

A review of some basic ideas in genetics is followed by a discussion of the problem of determining whether nucleic acids carry the genetic information in all organisms. J.Iball

575.17

9106. GENETIC FINE-STRUCTURE ANALYSIS. E.S.Lennox.
Rev. mod. Phys., Vol. 31, No. 1, 242-8 (Jan., 1959).

A discussion of the extent to which properties of the genetic map correspond to specific physical structures in the organism. A description is given of the kinds of experiment carried out, mainly on bacteriophage, to determine and recognise the several units of genetic material e.g. the recon, the muton and the cistron. It is concluded that the size of the units of recombination (recon) and mutation (muton) are of the order of magnitude of a few nucleotide pairs and the unit of function (cistron) is 10^2 to 10^3 pairs. J.Iball

576.3

9107. CELLULAR DYNAMICS. P. Weiss.
Rev. mod.Phys., Vol. 31, No. 1, 11-20 (Jan., 1959).

The living cell is a dynamic system rather than a static one and it is only by studying the actual cell that a real understanding of its behaviour can be achieved. Many examples are given of the way the shape of a cell depends on the environment in which it functions. Emphasis is placed on the use of time-lapse microcinematography to supplement the information obtained from stained specimens. As a consequence of such studies of cells in tissue cultures it is conjectured that the factors which determine the macro-structure of a biological system reside in specific ground substances secreted by the cells. J. Iball

576.3 : 539.19

9108. GENERAL PATTERNS OF BIOCHEMICAL SYNTHESIS. R.B.Roberts.
Rev. mod. Phys., Vol. 31, No. 1, 170-6 (Jan., 1959).

A discussion of synthetic pathways in the living cell. The flow of material in the synthesis of the precursors of biological macromolecules is considered mainly from the point of view of the isotopic competition technique. It is shown that various attempts to find intermediates more complex than amino acids and nucleotides have failed. J.Iball

576.3

9109. REPLICATION OF NUCLEIC ACIDS. R.C.Williams.
Rev. mod. Phys., Vol. 31, No. 1, 233-41 (Jan., 1959).

Experiments are described which give information regarding the conditions under which nucleic acid of bacteriophages is reproduced. It is concluded that at present it is premature and naive to expect that the models of DNA built on a two-strand helix pattern represent the way in which the structure is assembled within the living cell. J.Iball

577.15

9110. INDUCED ENZYME SYNTHESIS. D.S.Hogness.
Rev. mod. Phys., Vol. 31, No. 1, 256-68 (Jan., 1959).

A study of the increase in the ratio of the rate of synthesis of a given enzyme to the rate of synthesis of total cell protein resulting from exposure of cells to compounds (inducers) which are identical or structurally related to the substrates of the given enzyme. The system considered in detail is β-galactosidase of E coli. The experimental details are described and the main results are given. The theories put forward to explain the results are then critically examined. J.Iball

577.15 : 539.19

PROTEIN STRUCTURE AND ENZYME ACTION. See Abstr. 8780

577.15 : 541.128

MECHANISMS OF ENZYME ACTION. See Abstr. 8956

577.3

9111. MOLECULAR BIOLOGY AND THE PHYSICAL BASIS OF LIFE PROCESSES. F.O.Schmitt.
Rev. mod. Phys., Vol. 31, No. 1, 5-10 (Jan., 1959).

The introductory paper of a study programme in biophysical science which was held at Boulder, Colorado, in 1958. The way in which biophysics is developing is discussed and then a brief historical account of some theories of the structure and functioning of cells is followed by a statement of current concepts of cellular ultrastructure in relation to function. J. Iball

577.3 : 612.2

9112. RESPIRATORY-ENERGY TRANSFORMATION. A.L.Lehninger.
Rev. mod. Phys., Vol. 31, No. 1, 136-46 (Jan., 1959).

A summary of the broad outlines of current knowledge of some enzymatic and biophysical aspects of the conversion of respiratory energy into phosphate-bond energy. The "high-energy phosphate bond" of ATP and the part it plays in the energy cycle in aerobic cells is discussed in detail with considerable experimental data. The mechanical properties of mitochondrial membranes are discussed briefly and some biophysical problems associated with respiratory-energy conversions and "solid state" enzymology are indicated. J.Iball

581.132

9113. ENERGY RECEPTION AND TRANSFER IN PHOTOSYNTHESIS. M.Calvin.
Rev. mod. Phys., Vol. 31, No. 1, 147-56 (Jan., 1959).

A description of the way in which the green cells of plants are able to transform electromagnetic energy into chemical energy. Experiments with radioactive carbon were used to trace the sequence of events in the change of carbon dioxide into carbohydrate. Experimental details, the results and their interpretation are outlined. The latter part of the paper deals with the problem of how light, when absorbed by chlorophyll, promotes the synthesis of ATP and TPNH. J.Iball

581.132

9114. FREE RADICALS IN PHOTOSYNTHETIC SYSTEMS. M.Calvin.
Rev. mod. Phys., Vol. 31, No. 1, 157-61 (Jan., 1959).

A brief account of the use of electron spin resonance measurements in biological research with particular reference to the explanation of photosynthesis. (See preceding abstract). Several examples are given. J.Iball

612.17 : 534.232

INTRACARDIAC ACOUSTICS. See Abstr. 7898

612.84

9115. INFORMATION THEORY AND THE HUMAN VISUAL SYSTEM. J.R.Singer.
J. Opt. Soc. Amer., Vol. 49, No. 6, 639-40 (June, 1959).

Retinal neural connections may fulfil the roles of differentiating circuits. The limit to visual cognition is set not by retinal or optic nerve structure but by cerebral inertia. R.A.Weale

612.843

9116. PECULIAR FORM OF INTERACTION BETWEEN CONES AND RODS REVEALED BY THE ELECTRORETINOGRAM OF A HUMAN DARK-ADAPTED EYE. L.Ronchi.
J. Opt. Soc. Amer., Vol. 49, No. 4, 411-12 (April, 1959).

The fact that the b-wave decreases with an intensity increase once a critical stimulus intensity is exceeded is taken to indicate inhibition of rod function by cone activity. R.A.Weale

612.843

9117. PRIMARIES IMPLIED BY FRY'S FORMULATION OF DICHROMATISM AND THE MECHANISMS SUBSERVING COLOR VISION. D.L.MacAdam.
J. Opt. Soc. Amer., Vol. 49, No. 4, 415-16 (April, 1959).

It is shown that the identification of Fry's matching stimuli (Abstr. 960 of 1959) does not require a knowledge of tritanopic mixture data. R.A.Weale

612.843

9118. NOTE ON FACTORS INFLUENCING THE RELATION BETWEEN STEREOSCOPIC ACUITY AND OBSERVATION DISTANCE. D.Jameson and L.M.Hurvich.

J. Opt. Soc. Amer., Vol. 49, No. 6, 639 (June, 1959).

When only the binocular parallax angle varies with the distance of a test object stereoscopic acuity is independent of distance. When other depth clues come into play the total sensitivity is the sum of the sensitivities due to each clue. R.A.Weale

612.843

9119. QUANTUM EFFICIENCY OF HUMAN VISION. R.C.Jones.

J. Opt. Soc. Amer., Vol. 49, No. 7, 645-53 (July, 1959).

The detective quantum efficiency for foveal vision is computed from the flash perception data of Blackwell and McCready. The detective quantum efficiency is identical with the concept of quantum efficiency introduced by Rose in 1946, and is defined as the square of the ratio of the smallest possible threshold to the observed threshold, where the smallest possible threshold is set by the statistical fluctuations in the number of the background photons entering the eye. The computed values of the detective quantum efficiency Q are tabulated, and depend on the target diameter α, on the light pulse duration T, and on the background luminance B. The maximum values of Q (with the respect to variation of α and T) range from about 0.25% to about 1.0% over the range from 0.1 to 100 ft-L, with the maximum value occurring at about 1.0 ft-1. The computed values of Q are free of the questionable assumptions previously used by Rose and by Jones regarding integration time and threshold signal-to-noise ratio.

612.843 : 535.831.3

STUDIES OF THE LAWS OF VISION IN TELESCOPES. See Abstr. 8018

612.84.32

9120. APPARATUS FOR TOLERANCE MEASUREMENTS FOR THE CATARACT-INDUCING INFRARED RADIATION. A.Hinzpeter and R.Maass.

Optik, Vol. 15, No. 11, 676-85 (Nov., 1958). In German.

An apparatus is described which simulates the i.r. absorption characteristics of the eye and enables the i.r. energy absorbed by the lens to be determined. Results for various sources are quoted. E.A.Mussett

612.843.63

9121. THE VISIBILITY OF DETAILS OF A MOVING OBJECT. G.van den Brink.

Acta electronica, Vol. 2, No. 1-2, 44-9 (1957-58).

"Physical problems of colour television" Conference paper (see Abstr. 1006/1058). Conditions were examined in which a moving dark band sandwiched in between two light bands was visible. The bands were viewed extrafoveally; velocity v, exposure time t, stimulus intensity, and angular subtense D of the band were independently variable. For brief exposure times, a critical value of vt was discovered for every value of D, above which the dark band is invisible. R.A.Weale

612.85

9122. MASKING: WHY RESTRICT IT TO THE THRESHOLD LEVEL? M.F.Meyer.

J. Acoust. Soc. Amer., Vol. 31, No. 2, 243 (Feb., 1959).

Comments on a paper by Tanner (Abstr. 4178 of 1959) and on three definitions in the American Standards Association Acoustical Terminology Z24.1-1951. H.D.Parbrook

612.858.71

9123. RESIDUAL EFFECTS AT LONGER PRE-EXPOSURE DURATIONS. W.J.Trittipoe.

J. Acoust. Soc. Amer., Vol. 31, No. 2, 244 (Feb., 1959).

The lower limit of intensity for demonstrating residual effects at low noise levels is a decreasing function of the pre-exposure duration.

TECHNIQUE . MATERIALS

621-47 : 532.612

9124. TECHNIQUE OF OBTAINING A MINUTE PINHOLE IN A METAL PLATE. II. T.Numata.

J. Phys. Soc. Japan, Vol. 12, No. 11, 1312-13 (Nov., 1957).

For Pt I, see Abstr. 4610 (1958). The conditions under which a fine glass fibre can be pushed into a molten metal against surface tension, without bending, are considered theoretically and experimentally. A.R.Stokes

621.646.5

9125. RAPID-OPENING MECHANICAL GATE VALVE. B.P.Denardo and A.C.Charters.

Rev. sci. Instrum., Vol. 30, No. 5, 359-60 (May, 1959).

The construction and operation of the valve are discussed, and the results of operational tests given. In use, a port whose diameter is $1\frac{1}{4}$ in. can be completely opened in about 0.6 msec from the time a signal is fed to the valve unit.

621.791.3 : 539.26

X-RAY INVESTIGATION OF ALLOY PHASES IN SOLDERED JOINTS. See Abstr. 8911

622.785

9126. SINTERING OF QUARTZ CRYSTAL. A.C.D.Chaklader and A.L.Roberts.

Nature (London), Vol. 183, 1252-3 (May 2, 1959).

Gives experimental results on the sintering of quartz at temperatures of 1500°-1570°C (quartz-cristobalite transformation). Linear expansion, compressive strength, and composition (quartz/cristobalite) are shown graphically and an explanation to account for these results is advanced. E.G.Knowles

771.531 : 537.312.5

ON PHOTOCONDUCTIVITY OF PHOTOGRAPHIC EMULSIONS. See Abstr. 8148

771.531 : 539.1.07

AMIDOL DEVELOPMENT OF NUCLEAR EMULSIONS. See Abstr. 8423

LIST OF JOURNALS

The following list supplements the List of Journals published with the Index to Volume 61 (1958). Reprints of the List of Journals can be obtained from The Institution of Electrical Engineers, Savoy Place, London, W.C.2, price 2s.0d. post free.

The addresses given are believed to be correct at the date of publication, but no responsibility can be accepted for errors.

Automatisme	Automatisme. Dunod et Cie, 92 Rue Bonaparte, Paris, 6.
Canad. Electronics Engng	Canadian Electronics Engineering. Maclean-Hunter Publishing Company, 481 University Avenue, Toronto, Ontario; Maclean-Hunter Company, 125-130 Strand, London, W.C.2.
Elektrie	Elektrie. (Formerly: Deutsche Elektrotechnik). V.E.B. Verlag Technik, Oranienburger Str. 13/14, Berlin C 2.
Instrument Abstracts	Instrument Abstracts. (Formerly: Bulletin of the British Scientific Instrument Research Association). South Hill, Chislehurst, Kent.
Priborostroenie	Priborostroenie. Editorial address: ul. Gor'kovo b.6, Moscow K-9. [A translation is published as: Instrument Construction (Instrum. Constr.)].

NEW JOURNALS

Electrochimica Acta	Electrochimica Acta. Pergamon Press, 4 and 5 Fitzroy Square, London, W.1. Bi-monthly. Vol. 1, No. 1, dated April, 1959.
Instrum. Constr.	Instrument Construction. Produced for the Department of Scientific and Industrial Research by the British Scientific Instrument Research Association, South Hill, Chislehurst, Kent. Subscription address: Taylor and Francis, Red Lion Court, Fleet Street, London, E.C.4. Monthly. No. 1 dated January, 1959. [A translation of the Russian monthly journal Priborostroenie].

CHANGES OF TITLE

Bulletin of the British Scientific Instrument Research Association.
Title changed to: Instrument Abstracts with the issue dated June, 1959.

Dtsch. Elektrotech.	Deutsche Elektrotechnik. Title changed to: Elektrie [Elektrie] with the issue dated June, 1959.

ERRATA

Abstr. 3913 (1958) line 4 : for "(1957)" read "(1955)".
Abstr. 2249 (1959) line 6 : for "315" read "3.5".
Abstr. 2975 (1959) line 2 : for "V.S.Postinkov" read "V.S.Postnikov".
Abstr. 7748 (1959) line 11 : for "ΔV" read "ΔU".
Abstr. 8382 (1959) line 13 : for "Cn" read "Cu".

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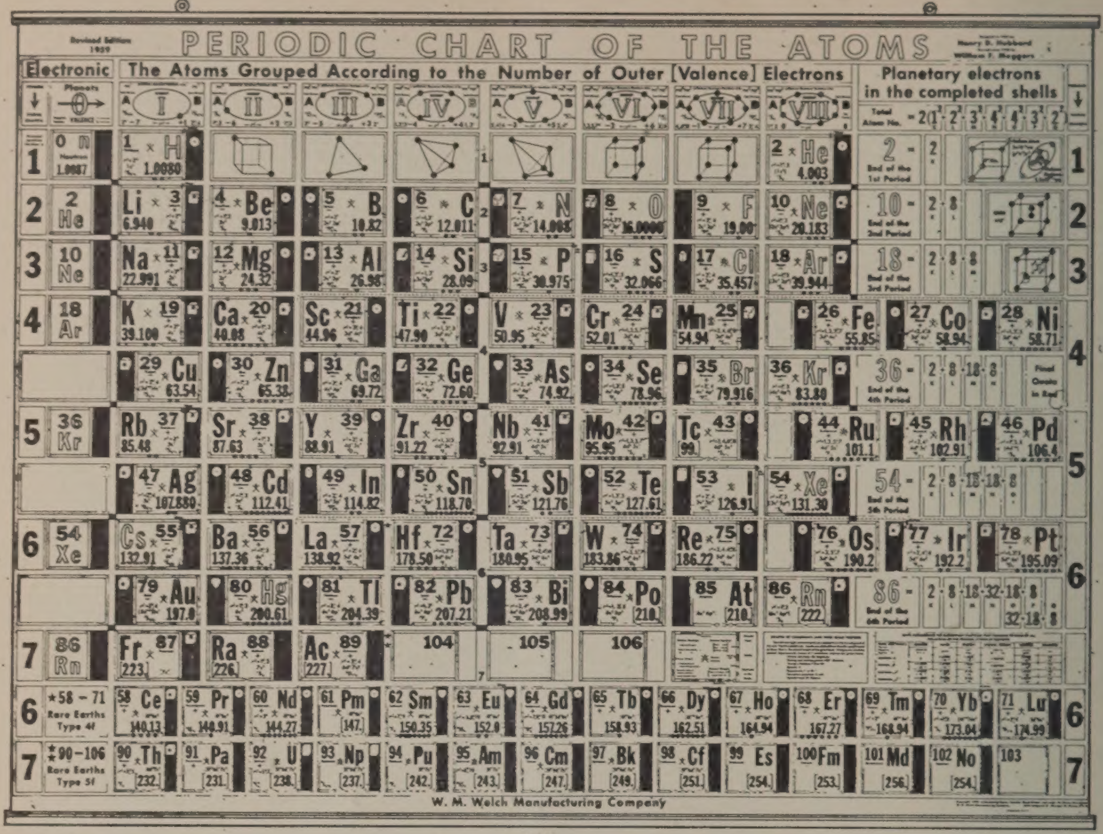

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